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NEW YORK, THURSDAY, APRIL 6, 1911.

CONTENTS.

Editorials 819
Meetings of A. I. E. E. 822
Central-Station Welfare Work 822
Meeting of the Electric Vehicle Association of America 822
American Institute of Consulting Engineers 823
Convention of Iowa Electrical Association 823
Convention of the Southwestern Electrical and Gas Association 823
Congress of Technology at Boston 823
The Schaefer Resuscitation Method in England 824
Mechanical Device for Resuscitation from Electric Shock 824
Boston Edison Company Opens Electric Garage 824
Cost of Energy in Toledo 825
Electric Development at Portland, Ore. 825
Chicago Freight Tunnels 825
Central Station Development on Vineyard Sound 826
Electrolytic Corrosion of Iron in Concrete 827
Electrical Resistance of Wood Treated with Preservative 828
Importance of Fundamentals in Engineering Education 828
St. Louis Valuation and Rates 829
Commission News 830
Current News and Notes 833
Steam Turbine Generating Station at Stillwater, Minn 837
Modern Alternating-Current Coal Docks at Duluth, Minn 839
Model Small Municipal Plant at Princeton, Ill 841
Typical Locomobile Electric Plants. By Warren H. Miller 842
Distribution-Line Construction in Minneapolis 845
Use of Low-Grade Fuel in British Producer Plant 846
Meter Department Notes. By T. B. Morgan 846
Slide-Rule Errors. By W. L. Durand 848
Electricity from a Swedish Peat Bog 848
Notes on Combustion of Fuel. By John B. C. Kershaw 849
Letters on Practical Subjects 851
Questions and Answers 855
Domestic Heating-Appliance Efficiencies 857
Tabulating Machines for Checking Bills at Chicago 858
Six Thousand Luminous-Arc Lamps for Cincinnati 858
Exhaust Steam Heating as Developed by a Large Central Lighting Station. By E. Darrow 859
Sign Lighting in Louisville, Ky. 861
Freight Yard Lighting. By W. S. Austin 862
LETTERS TO THE EDITOR:
The Comparison of Illuminants. By R. Hillberg 864
Canadian Electrical Association. By P. S. Coate 864
Digest of Current Electrical Literature 864
Book Reviews 868
New Apparatus and Appliances 869
Industrial and Commercial News 877
General News 881
Weekly Record of Electrical Patents 890

A LESSON IN ECONOMY.

The article by Mr. Warren H. Miller in this issue on the so-called locomobile electric plants is one which ought to bring a blush to the cheeks of our countrymen who pride themselves on their progressiveness in engineering matters and in manufacture. We have been preaching superheated steam in season and out of season for some years past and even now its use is only sporadic. When one looks at the record of the German units his patriotic fervor for American enterprise receives something like a cold douche. When one considers that there are many thousands of these units in use varying from less than 100 hp to 600 hp and on the average producing the hp-hour on less than 10 lb. of steam he can only wonder in a dazed sort of way how our engineers and manufacturers have allowed themselves to be outdone without a single recorded effort in self-defense. The typical locomobile superheated steam unit is merely an intelligently designed self-contained combination of boiler, superheater and compound condensing engine, so arranged as to eliminate as far as possible all the incidental heat losses and consequently to operate at an enormously high efficiency.

In one of the typical plants described by Mr. Miller the units are of only 200 hp, but by means of double superheating the coal consumption is brought down to barely over 1 lb. per hp-hour. This remarkable result is obtained simply by intelligent design. The engines are compound condensing and the cylinders are jacketed in the steam dome. The steam at 170 lb. pressure is carried to a temperature of 570 deg. before it enters the high-pressure cylinder, is expanded down to about 260 deg., rises in the low-pressure superheater to about 370 deg., is expanded down to about 150 deg., and even then passes through a feed-water heater to give up the last available thermal unit. The total floor area occupied by the plant is only 45 ft. x 60 ft. and the saving both of fuel and labor over ordinary American practice is enormous. This same kind of performance is repeated over and over again in similar plants throughout Germany and the great industrial territory scattered all over the world which is gradually becoming tributary to German enterprise. The performance of these units even with poor coal is something extraordinary in the way of economy.

With the introduction of apparatus of this kind the reciprocating engine gets a new lease of life. Fine as are the results which have been obtained from American steam turbines, one can only too readily fancy the look of horror that would come over a turbine engineer if casually asked to guarantee a performance of 10 lb. of steam per brake hp-hour on a 200-hp unit. Indeed, he would be grievously worried to duplicate the best performances of these little superheated steam sets with an equipment of any rating whatever. It is putting it mildly to say that machines of this class are capable of cutting the coal con-

sumption and labor in two, as indeed the properly planned superheating plant should. They are doing the work which in this country is mostly done by high-speed single-cylinder engines using at least 30 lb. of steam per indicated hp-hour and requiring the service of two men instead of one. We hear rumbling in the distance a deprecatory chorus about upkeep and repairs, but the fact is that the Continental engineers have already had a good deal of experience with superheated steam and are not in the least afraid of it, while high superheating is here looked upon with the distrust that is born of ignorance. If any one thinks that we are putting the case too strongly, let him the next time he wants a small generating unit try the experiment of asking bids on a superheated steam equipment with a guarantee of 10 lb. of steam per brake hp-hour. It would be interesting to see the correspondence which would follow the proposition.

The simple fact is that the American mania for so-called standardization has blinded us on this side of the water to what is really going on in the world. High superheating doubtless has its difficulties like every other improvement. Yet the Continental engineers who are working along that line lack neither in skill nor in experience and would not be willing to send equipment of this kind to the ends of the earth to be run by untrained men unless they were prepared to stand back of it. American manufacturers, we may be proud to say, can do as good work as any in the world, and American engineers are fully capable of holding up their end, but the latter cannot move until the former tell them to go ahead and the former consistently dodge the introduction of unfamiliar apparatus until they are clubbed by commercial pressure into the path of progress. They move along the path of least resistance and unfortunately this is not upon an up grade. We understand fully the commercial forces that tend toward standardization of output and we do not undervalue the convenience of this standardization, yet the time comes when a break has to be made, and when this time comes it is necessary to work quickly. In our judgment the psychological moment in superheated steam work is near at hand. Suppose, for example, the not impossible case of the abolition of the tariff on such machinery as is here under consideration and the subsequent irruption of active German agencies. How, indeed, could competition be met if the tariff were even materially lowered? If our American manufacturers do not brace up and meet the situation they will wake up some fine morning to find their business imperiled. Making all due allowances for possible German over-enthusiasm and for possible unforeseen difficulties, the fact remains that the apparatus here described has passed the experimental stage and has brought the generation of electrical energy from steam onto a new plane of economy.

ELECTRICAL PUMPING FOR WATER-WORKS.

Numerous installations have demonstrated long since the entire practicability of driving pumps in water-works stations by electric motors. In city water-works reliability of service is an essential, of course, and it has been shown that electric motors may be relied upon to do the work. However, steam-pumping engines, operating at steady load, represent reciprocating engines at their best, and there has been some question whether the electric pumps could equal them in economy of operation. The question is materially influenced. naturally, by the cost of electrical energy on the one hand and of steam production on the other.

A test is to be made at the West Side pumping station of the Chicago municipal water-works system that should throw some light on the subject. In this case electrical energy is to be obtained from the hydroelectric development on the Chicago Drainage Canal to operate two centrifugal pumps, each capable of delivering 25,000,000 gal. daily under a total head of 115 ft. Energy will be sold to the city by the Sanitary District at a rate which will be low, perhaps $15 a hp-year for twenty-four-hour operation. The pumps will be driven by synchronous motors. The pumps will be installed under conditions that will permit of exact measurement of the electrical energy consumed and the water pumped. It will be possible, therefore, to make an interesting determination of the cost of pumping water into the city mains under these especially favorable conditions. No doubt it will be low, including interest and depreciation, and probably less than the cost of steam pumping. If so, it is probable that the use of electric pumps will be extended gradually to other pumping stations of the city, for the Sanitary District, which governs the Drainage Canal, has sufficient energy available or in sight to drive all the pumps of the water department that it would be safe to operate by electricity alone. It will hardly be considered safe engineering to have all the pumps of the city driven by Drainage Canal power because the transmission line, although exceptionally well built, is thirty miles long, and in the event of a great conflagration it would be hazardous to be dependent exclusively upon it.

PROMOTING THE USE OF ELECTRICITY IN FARMING DISTRICTS.

It is gratifying to observe that the possibility of extending greatly the use of electrical energy in rural districts—a subject to which this journal has devoted considerable attention—is now engaging the earnest attention of many central-station operators. The National Electric Light Association's committee on "electricity in rural districts," appointed recently, is busily at work and has collected already data of much value to form the basis of a useful report, while it has nearly two months remaining in which to work and still present its findings to the secretary of the association a month before the convention, as all good committees should strive to do. The committee consists of eight members residing in the States of Massachusetts, New York, Illinois, Nebraska, Colorado and California. It is thus widely distributed geographically, and as to each man is assigned a certain territory to cover in making the investigation the report should be of value and of local application in all sections of the country.

The committee, through its chairman and its members, asks the co-operation of all central-station men who can give it information of actual installations of electric lamps, motors or other appliances on farms or country estates, or, generally, in the rural districts. Attention is directed more particularly, of course, to what has been accomplished, or what it is hoped to accomplish, in the United States and Canada; but some attention will also be given to foreign practice in relation to rural distribution and application, for it must be confessed that France, Germany and Italy have something to teach us in this respect. The work of supplying electricity along country high-

ways is now in the pioneer stage, but there seems to be no question that this development is one which is bound to be greatly extended. The N. E. L. A. committee is trying to take note of what has been accomplished and to call particular attention to what seem to be the best methods of meeting the situation, which, with boundless possibilities, is not without its perplexities. Investigations of this kind are of self-evident value, and the National Electric Light Association is perhaps the organization best fitted to undertake them. We trust that all readers of this journal who are interested in rural electrical distribution will give the committee the benefit of their experience.

"GOING VALUE" OF PUBLIC UTILITIES.

In a recent decision of the Oklahoma Supreme Court, reported in these columns, it was held that the valuation of a telephone plant, for rate-making purposes, should include an allowance for "going value." This is but another instance of the fact, which the courts have usually recognized, that "going value" is an essential element in determining the value of a public utility. Few utilities, if any, can be made self-sustaining from the first day of their operation. Several years must elapse before the earnings are sufficient to cover operating expenses, including depreciation and a reasonable rate of interest on the investment. The amount by which the earnings fail to meet these requirements may be regarded as a deficit, and, as such, constitutes a part of the cost of building up a business. This loss is unavoidable in the early years of every public utility. The question has been whether this loss shall be borne by the owners of the plant, by the initial consumers, or be treated as a part of the investment, or value of the plant, constituting the basis upon which consumers shall pay interest. The public cannot expect, as a business proposition, that the loss shall be borne by the utility, for investors in public-service corporations expect and deserve a return upon their investments from the time when they were made, and if the law required that a portion of the investment should yield no return it would be a difficult matter to induce capital to favor this form of investment; nor would it be fair to the capital already invested. It is not evident that this loss should be borne by the initial consumers in the form of excessive rates, but there may be cases where it is desirable that the losses be carried along and written off out of the surplus earnings. When "going value" is capitalized it becomes a permanent charge upon the consumers and is included in the valuation upon which interest is earned. Under these conditions the burden is distributed among those who receive the benefits of the expenditures and the use of the public utility in its enhanced value. This method seems the most logical and satisfactory way of dealing with the problem.

"Going value" is not a mere unearned increment in every case; neither should it be the means of fictitiously increasing values or creating values which do not exist. It is too often made the excuse for unreasonable charges by those public utilities whose rates are based upon what the public will bear. When unrestricted it becomes an evil pretty closely associated with watered stock The cost of building up a business admits of approximate computation and should be determined when it is to be made an element of total valuation. It has been held, however, that the expenditures and deficits involved must be legitimate and reasonable, and should not include items that have been incurred under other than usual conditions, or items that could have been avoided by the exercise of ordinary care and business judgment. The element of "going value" is, in short, an item which requires careful analysis if justice is to be done both consumer and utility. Although authorities agree as to its reasonableness, it is not a value that can be assigned arbitrarily. It has a distinct value in each case, depending upon the particular circumstances involved; it may be positive, zero or even negative, and is closely associated with the entire financial history of the utility. While the courts are competent to pass on the equity of the question, the determination of what constitutes a fair and equitable amount to be charged against the capital account for building up a business requires a discretion and a technical knowledge of the matters involved which the courts are not presumed to possess. Questions of this nature can best be handled by those whose training and experience fit them to take an accurate and unbiased view of the factors involved. To determine the cost of building up a business is not always an easy matter. To ascertain it may require an extended knowledge of the economies of utility operation and a considerable number of data relating to the plant in question or to other plants similarly situated. The work is often rendered difficult by the fact that so few utilities ordinarily, unless compelled to by commission control, keep an accurate account of all the expenses incurred in building up their business.

Much excellent work upon the subject of "going value" has been done by the Wisconsin Railroad Commission. Its aim in the cases before it has been to ascertain, in so far as possible, the unrequited expenditures incurred in establishing the business of a public utility upon a basis where operating revenues become adequate to meet all the legitimate demands of the utility. One of the methods employed was outlined recently in the summary of a case in these columns. In this case the company and its experts testified that a sum of $300,000 should be allowed for going value, and that this amount should be added to the total valuation. The commission found that the company was entitled to no "going value" whatsoever, inasmuch as the cost of building up the business had been more than made up through excessive rates extending over a period of years. This decision was not offhand, but the result of great care in gathering statistics conclusively accurate. Besides the Oklahoma Supreme Court previously mentioned, several other courts and utility commissions have followed the methods of the Wisconsin Commission in forming an estimate of the amount to be allowed for building up a business, and with satisfactory results. It is obvious that "going value" is an element which must be taken into consideration, and it is equally apparent that some logical method must be employed in fixing this value. It cannot be said that any one method is the exclusive one except as results show it to be the most equitable. The question of "going value," which affects so materially the total valuation of any public utility, merits the most careful consideration on the part of trained and experienced men, for both utility and consumer are vitally concerned in its correct determination.

Meetings of A. I. E. E.

A meeting of the American Institute of Electrical Engineers will be held in the Engineering Societies Building, New York, on April 14. The following papers will be presented: *The Effect of Temperature Upon the Hysteresis Loss in Sheet Steel,* by Prof. Malcolm MacLaren, of the electrical engineering department of Princeton University, and *Commercial Testing of Sheet Steel for Hysteresis Loss,* by Mr. L. T. Robinson, engineer, General Electric Company, Schenectady, N. Y.

PACIFIC COAST MEETING.

At the Pacific Coast meeting of the Institute to be held in Los Angeles on April 25, 26, 27 and 28 the following papers will be presented and discussed: *Transmission Applied to Irrigation,* by Messrs. O. H. Ensign and J. M. Gaylord; *Cisoidal Oscillations,* by Mr. G. A. Campbell; *Continuity of Service in Transmission Systems,* by Mr. M. T. Crawford; *New Automatic Telephone Equipment,* by Mr. Charles S. Winston; *Auto-Manual Telephone Systems,* by Mr. Edward E. Clement; *Some Recent Developments in Railway Telephony,* by Mr. Gregory Brown; *Electricity in the Lumber Industry,* by Mr. E. J. Barry; *The Refining of Iron and Steel by Induction-Type Furnaces,* by Mr. C. F. Elwell; *Transmission Systems from the Operating Standpoint,* by Mr. R. J. C. Wood; *A Power Diagram Indicator for High-Tension Circuit,* by Prof. Harris J. Ryan.

Arrangements have been made for transportation on the Supply Jobbers' special train which will leave Chicago on April 18 over the Santa Fé route. The rate of fare from Chicago to Los Angeles and return on the special train or on other trains leaving April 18, 19 or 20 will be $72.50.

TORONTO MEETING.

A meeting of the Institute will be held in Toronto on April 7. A paper will be presented by Mr. W. S. Murray, electrical engineer of the New York, New Haven & Hartford Railroad Company, entitled *Electrification Analyzed, and Its Practical Application to Trunk Line Roads, Inclusive of Freight and Passenger Operation.* The paper is an analysis of the electrical operation of the New York, New Haven & Hartford Railroad, which it compares with steam operation, and shows a decided advantage in favor of the former.

Central-Station Welfare Work.

The public policy committee of the National Electric Light Association held a meeting in New York on March 28, when the report on welfare work as related to the central-station industry was adopted and the recommendations were put in shape for presentation at the annual convention in New York in May. The plans proposed include accident insurance, sickness insurance and death benefits, service annuities, profit sharing, employees' savings and investment funds and life insurance, although with regard to the last item it is suggested that the companies limit themselves to providing their employees with all possible information in connection with safe low-cost life insurance and do not put in force any plan of their own.

The report will give in detail the methods by which provision can be made under each of the other heads. By unanimous vote the term "pension" has been dropped and the service annuity adopted as the recognition of an automatic recompense for continuous service, and the committee expressed the opinion that member companies should provide such annuities for every male employee reaching the age of sixty-five and every female employee of sixty years after continuous and satisfactory record of ten years of service. The details of profit sharing are based upon the idea that it is better to have those engaged in the industry as partners rather than as employees; that preferably profits of the employee based upon his wage scale should reach him in the securities of his company, and that dividends upon such securities should be paid in cash, in the manner customary with other security holders. Details are also given with regard to savings funds and investment funds, with the object of promoting thrift among employees and, where feasible, combining the plan with profit sharing, it having been found that the two work out very satisfactorily together.

The personnel of the committee is Mr. Charles L. Edgar, chairman, president of the Edison Electric Illuminating Company, Boston, Mass.; Messrs. Nicholas F. Brady, vice-president of the New York Edison Company; Charles A. Stone, of Stone & Webster Corporation; H. M. Byllesby, whose company is also operating and managing numerous central-station properties; Henry L. Doherty, president of the Denver Gas & Electric Company; W. W. Freeman, president of the National Electric Light Association and vice-president of the Brooklyn Edison Company; Samuel Insull, president of the Commonwealth Edison Company, Chicago; Joseph B. McCall, president of the Philadelphia Electric Company; Samuel Scovil, vice-president of the Cleveland Electric Illuminating Company, and General George H. Harries, vice-president of the Washington (D. C.) Railway & Electric Company; Mr. Everett W. Burdett, counsel of the N. E. L. A., and Mr. Arthur Williams, of the New York Edison Company, vice-chairman of the committee. The committee has also had the active co-operation of Mr. Thomas E. Murray, president of the Association of Edison Illuminating Companies, and Messrs. W. H. Blood, Jr., and R. S. Hale.

It is believed that it is the first time in the history of the country that an association representing so many corporations and representing over 90 per cent of the investment and earnings in the industry for which it stands has taken up such a subject in this comprehensive and thorough-going manner, and the report itself will be awaited with the utmost interest by all connected with public utilities and by economists in general.

Meeting of the Electric Vehicle Association of America.

At the regular monthly meeting of the Electric Vehicle Association of America held in the Engineering Societies Building, New York City, March 28, President Blood announced that the publicity committee had already raised a fund of over $23,000 among the central-station companies and that it was expected to raise $25,000 among the manufacturers. The money will be used in a national publicity campaign on the electric vehicle. The standardization committee, he also announced, expects to make definite recommendations shortly on charging plugs for pleasure vehicles. Mr. Frank W. Smith, speaking for the membership committee, stated that including the Electric Vehicle and Central Station Association of Boston the membership of the association now totals 240.

The topic of the evening was "Tires: Their Use and Abuse," by Mr. D. C. Swander, of the Firestone Tire & Rubber Company, New York. The author considered pleasure and commercial vehicles separately and said that opinion differed as to the superiority of solid or pneumatic tires for pleasure-vehicle work. Manufacturers design the springs of cars with a view to using one or the other kind of tire equipment. His company's experiments show that the pneumatic tire designed for service on electric pleasure vehicles cannot be made to secure both economy in energy consumption and satisfactory mileage, and for that reason has dismissed pneumatic tires as a serious possibility on pleasure cars. Solid tires are made in various shapes and standardization is most needed in the cushion type, where variations in the volume of rubber are as high as 40 per cent between different makes. For commercial electric vehicles solid tires are essential, pneumatics being quickly destroyed on account of the great loads. The side-wire tire in both channel and flange types is in wide use, and lately the dual motor tire has been adopted for rear wheels of heavy cars. The author described the various types of tires, pointing out the improvements made within recent years to overcome certain defects which long experience and use have revealed. Mr. Swander pointed out the importance to the electric vehicle trade of a tire which will not call for undue expenditure of electrical energy and which will give ample resiliency to prevent jarring

the batteries and to protect the mechanism. A hard tire will show decreased energy consumption in the vehicle, but damage to battery and mechanism, while a resilient tire that will absorb stones and pebbles will result in excessive energy consumption and insufficient mileage. A tire which is a mean of these and combines economy of energy with proper resiliency is expensive if it also entails good wearing quality. The ease of repairing solid tires was emphasized. The author claimed that there is great room for improvement in solid-rubber tires. Reduced tire expense is possible, he said, if cars are equipped with a tire of adequate size. The following tire sizes were recommended:

Size of Tires, Inches.	Carnegie Channel, Inches.	Endless Channel, Rim No.	Extreme Load, Pounds
2	2½	2	500
2½	3	2½	750
3	3½	3	950
3½	4	3½	1375
4		4	1750
5		5	2000
6		6	3000
7		7	4000
2½ Dual	Two 3	Two 2½	1900
3 Dual	Two 3½	Two 3	2500
3½ Dual	Two 4	Two 3½	3500
4 Dual		Two 4	5000

If properly cared for and inspected tires can be made to give ample service. Nine suggestions on the care of tires which aim in reducing the most common abuses were appended to the paper. These are printed on a placard by the Firestone company for the guidance of drivers.

The paper was discussed by Messrs. Blood, Lloyd, Wagoner, Wilcox, Stoughton, Appleton, Marsh and Phillips, the discussion consisting chiefly of questions for the author to answer.

American Institute of Consulting Engineers.

The American Institute of Consulting Engineers, recently organized, has now a membership of forty-two. Membership in the body is limited by the constitution to engineers actively engaged in the practice of their profession as consulting engineers and who are not engaged in contracting. A candidate to be eligible for membership must be at least thirty-five years of age, must be a full member in good standing in one of the national civil, electrical, mechanical or mining engineering bodies, or have been an engineer officer in the United States army or navy. Election to membership requires seven favorable votes of the total nine votes of the council. The entrance fee is $10 and the annual dues $25.

An official annual ticket for election of officers is prepared by a nominating committee of three members of the Institute appointed by the council. Other nominations may be made in writing, which, if signed by at least fifteen members, are mailed to each member.

The present officers of the body are Mr. Alfred P. Boller, president; Mr. Gustav Lindenthal, vice-president, and Mr. Eugene W. Stern, 103 Park Avenue, New York, secretary. The following electrical engineers are members of the society: Messrs. Frank J. Sprague, L. B. Stillwell, George F. Sever, C. O. Mailloux and L. B. Marks. Among leaders in other branches of engineering who are members in addition to the officers above named are Gen. T. A. Bingham, Prof. George F. Swain, Messrs. E. L. Corthell, Rudolph Hering, H. W. Post, W. J. Wilgus, R. P. Bolton, J. F. Wallace, Charles Sooysmith, Henry R. Buck and F. A. Molitor.

Convention of Iowa Electrical Association.

At the eleventh annual convention of the Iowa Electrical Association, to be held in Davenport on April 19 and 20, the following papers will be presented: *Waterloo Transmission Records*, by Mr. Ira L. Craig; *Underground Distribution in Medium-Size Cities*, by Mr. H. B. Gear; *Refrigerating Advantages and Disadvantages*, by Mr. G. W. Du Mont; *Flat Rates for Small-Demand Consumers*, by Prof. A. H. Ford; *The Electric Automobile*, by Mr. F. H. Golding; *Methods of Securing Motor Loads and Properly Installing the Apparatus*, by Mr. Harry G. Glass; *Ornamental Curb Illumination*, by Mr. J. D. A. Cross; *Public Policy*, by Mr. George Carson.

The entertainment features include a smoker on Wednesday evening, when a vaudeville performance will be witnessed. On Thursday evening the members will be taken in a party to one of the theaters. Immediately after the theater performance the Sons of Jove will hold a rejuvenation at Kimball Hotel. The president of the association is Mr. Thomas Crawford, Clinton; the secretary is Mr. W. N. Keisen, Dubuque.

Convention of the Southwestern Electrical & Gas Association.

Several of the papers to be presented at the convention of the Southwestern Electrical & Gas Association at Houston, Tex., on April 27, 28 and 29 will be of special interest to electrical engineers. Among these are the following: *Investigation and Care of Return Currents*, by Mr. George H. Clifford; *Development of Electric Motor-Service Business*, by Mr. P. A. Rogers; *Practical Tests of Railway Equipment.*

A committee, of which Mr. M. B. Wheeler, 602 Preston Boulevard, Houston, is chairman, is making arrangements for an elaborate electrical show to be held in the Municipal Auditorium, where the meetings will also be held. The show will be conducted on a co-operative plan; any excess of income from exhibit spaces above expenditures will be returned pro rata to the exhibitors.

The Sons of Jove will hold a rejuvenation on April 28.

The president of the association is Mr. W. B. Tuttle and the secretary Mr. D. G. Fisher, 1316 Commerce Street, Dallas.

Congress of Technology at Boston.

The Congress of Technology to celebrate the fiftieth anniversary of the founding of the Massachusetts Institute of Technology will be held at Boston on April 10 and 11, 1911. The sessions will be open to the public, and a large number of papers are to be read by graduates of the institute on topics of an industrial, economic and engineering character. The practical applications of science to the affairs of modern life will be surveyed by authorities in different fields, and the conditions and problems in many industries will be reviewed. Members of the institute faculty will also contribute to the discussions.

The papers will cover such general subjects as architecture, business administration, economics, public health and factory sanitation, industrial organization and education, power production and distribution, materials and manufacturing processes, and the reclamation of arid lands. Among the speakers and topics of electrical and allied interests will be the following: "Reliability of Materials," by Mr. Walter C. Fish ('87), manager Lynn works, General Electric Company; "Scientific Industrial Operation," by Mr. Tracy Lyon ('85), assistant to vice-president, Westinghouse Electric & Manufacturing Company; "Scientific Management," by Mr. David Van Alstyne ('86), Allis-Chalmers Company, Milwaukee; "The Control of Thermal Operations and the Bureau of Standards," by Mr. George K. Burgess ('96), Bureau of Standards, Washington, D. C.; "Coal Combustion Recorders," by Prof. A. H. Gill ('84), Massachusetts Institute of Technology; "Thirty Years' Work in Boiler Testing," by Mr. George H. Barrus ('74), consulting engineer, Boston; "Analysis of Some Losses of Efficiency in a Large Producer-Gas Plant," by Mr. J. G. Callan ('96), electrical engineer, Arthur D. Little, Inc., Boston; "Power-Plant Betterment," by Mr. H. H. Hunt ('89), Stone & Webster Manage-

ment Association, Boston; "The Engineer and Architect Unite," by Mr. L. S. Cowles, Boston Elevated Railway Company, Boston; "An Electric Furnace for Zinc Smelting," by Francis A. Fitzgerald ('95), consulting engineer, Niagara Falls, N. Y.; "The Improvements in Efficiency of Electric Lighting Properties and What the Public Gains Through These Improvements," by Mr. William H. Blood, Jr. ('84), technical expert, Stone & Webster, Boston; "The General Solution for Alternating-Current Networks," by Mr. George A. Campbell ('91), research engineer, American Telegraph & Telephone Company, New York; and "Research as a Financial Asset," by Mr. Willis R. Whitney, director research laboratory, General Electric Company, Schenectady, N. Y. Among the other speakers whose topics are not yet announced will be Messrs. Henry G. Bradlee, of the firm of Stone & Webster, Boston, and Louis A. Ferguson, second vice-president Commonwealth Edison Company, Chicago.

The congress will be concluded by a subscription banquet in Symphony Hall, at which addresses will be made by speakers of national reputation. Mr. Walter Humphreys, 491 Boylston Street, Boston, is active in the preparations.

The Schaefer Resuscitation Method in England.

Our correspondent in Berlin, Germany, in a recent interview was informed by Prof. Gisbert Kapp, of the University of Birmingham and formerly secretary of the German Electrical Association, that, according to information received from Professor Cadman, of the University of Birmingham, the Schaefer method of artificial respiration has been employed with good success in England and is there almost universally in use. English experience is, therefore, not in agreement with the opinion of German specialists as indicated in the report of the National Board of Health of Germany against the use of the Schaefer method in Germany.

Mechanical Device for Resuscitation from Electric Shock.

The Bureau of Mines, Washington, D. C., has received for test an oxygen resuscitating apparatus made by the Dräger-Werke, Lubeck, Germany, an illustration of which is shown herewith. The apparatus was designed for resuscitation of persons from

Resuscitation Apparatus.

apparent death by drowning or by electric shock, or who are overcome through the inhalation of irrespirable gases.

The operation of the device consists in inflating and deflating the lungs by means of oxygen. The apparatus consists of a cylinder in which oxygen is stored under a pressure up to 125 atmospheres, a blowing and suction valve actuated by two accordion bellows, a face mask which incloses the mouth and nose, making an air-tight connection with the face, to which mask are attached two flexible tubes leading to the blowing and suction valves respectively.

When the mask is made air-tight on the face and the oxygen is turned on, the apparatus works automatically. Oxygen is forced into the lungs until a pressure of 4 in. of water gage is reached, which pressure is in connection with one of the accordion bellows, and owing to the elongation of the bellows under this pressure the valves are operated and the pressure in the lungs is released. The suction immediately begins operation and continues to exhaust the oxygen from the lungs until a vacuum of 4 in. of water gage is reached. The oxygen used for creating this partial vacuum deflates the bellows and changes the position of the valves, allowing the oxygen again to be forced into the lungs, etc. A lever enables the inflow and outflow of oxygen to be regulated by hand independent of the automatic device.

The application of the device necessitates placing the subject on his back, in which position the tongue may fall to the back part of the throat, allowing the soft palate to close the larynx. To overcome this condition a flexible rubber tube is attached to the upper part of the face mask which will admit of grasping the tongue with a pair of forceps and withdrawing it sufficiently to raise the soft palate.

Another type of mask is one which fits over the nose and nostrils only, allowing the mouth to be free. With the use of this nose mask the tongue may be withdrawn and held between the teeth and lips with sufficient pressure to hold it in place and make the mouth air-tight. For the successful use of the apparatus it is necessary that an air-tight fit be made with the type of mask used.

Attached to the lid of the pulmotor box is an inhalation device which may be substituted for the pulmotor as soon as the subject responds to treatment. This inhalation device is fitted with a rubber bag which holds 2 liters of oxygen when inflated and a metallic mask which fits over the mouth and nose and which may be held in place with a rubber band passing around the head.

A lever at the hinged end of the box has the enameled inscriptions "Pulmotor" and "Inhalation." Whichever name is exposed indicates the manner in which the apparatus will operate—"Inhalation" or "Pulmotor." To demonstrate the pulmotor action of the device there is provided a rubber bag and disk which may be attached to the face mask. The rubber bag when fitted represents the lungs of a subject being treated.

Boston Edison Company Opens Electric Garage.

An important step forward in the Boston electric vehicle campaign was taken on April 3 in the opening by the Boston Edison Company of a public garage for electric vehicles at 476 Atlantic Avenue, adjoining the company's downtown generating station. The garage at present occupies a space about 125 ft. long by 63 ft. wide on the company's property at the foot of Congress Street. It is centrally located on the Boston water front with easy access to the main teaming thoroughfares of the city, and has a capacity of about twenty-five vehicles. It is completely equipped with charging facilities, and within a few days twenty-four trucks or pleasure vehicles can be charged simultaneously at the station. Artificial lighting is to be furnished by an installation of fifteen 150-watt tungsten lamps placed inside prismatic glass reflectors about 15 ft. above the floor, and the lighting service will be metered separately from the energy used in battery charging. Energy is supplied from the Atlantic Avenue station by three No. 0000 copper cables carrying 110 volts and 220 volts standard three-wire direct-current service. The garage will charge a fixed rate per month for its service, depending upon the size of the vehicle. The price will include the usual care, including washing, charging and adjustments. The charging outlets are arranged in the form of bushings carried in water-proof and short-circuit-proof cases closed by a spring-actuated hinged cover, and all connections to vehicle batteries will be made by a flexible cable with a plug at each end, the plug being so arranged that if a vehicle starts

while connected to the charging outlet the cable will simply pull out of the bushing and fall upon the floor without damage. Mr. A. G. Campion is in charge of the garage, which is to be operated under the general supervision of Mr. E. S. Mansfield, of the Boston Edison company, and under the auspices of the Electric Vehicle Association of America. On the evening of the opening day the company entertained at dinner at the Hotel Thorndike, Boston, the dealers in electric pleasure and commercial vehicles now established in Boston.

Cost of Energy in Toledo.

On March 29 Mr. F. B. Ford, of Ford, Bacon & Davis, New York, appeared before the Council committee of the whole at Toledo, Ohio, and made a report on the cost of producing and transmitting energy for residence lighting purposes, together with the cost of maintenance and other items. This was done at the instance of the Toledo Railways & Light Company, which is now asking for a new contract from the city.

Mr. Ford said that a fair rate for residence lighting would be 12 cents per kw-hour, with 10 per cent discount for the payment of bills within ten days, instead of 9 cents with a discount of 10 per cent, as at present charged. He said that the company had received a return of only 2.2 per cent on the investment in its lighting department and that the rate he proposed would allow it about 8 per cent after making provision for depreciation, taxes, operating expenses and other things that naturally come in.

The cost of delivering energy to residences, including 8 per cent return on the investment, operating and other expenses, is 10.8 cents per kw-hour, Mr. Ford said. Mr. Ford put the cost of energy at the switchboard at 1.2 cents, although President Lang had said that it is 0.75 cents.

Mr. Ford's report showed that the cost of serving residences in 1910 was $29.94 each. This is figured at a profit of 8 per cent on an investment of $130 for each consumer. The average revenue for the year, he said, was $22.36. The difference, deducted from a reasonable return of $10.40 on the investment of $130 per customer, leaves a profit of $2.82, or 2.2 per cent interest on the investment.

It was shown that there are 6405 residence and 1326 business consumers who pay more than 5 cents per kw-hour. Together they comprised 81 per cent of the total number of lighting customers for that year and contributed only $225,790.70, or 36 per cent of the total receipts. During the same year 64 per cent, or $396,560.79, of the total receipts was paid by 1883 consumers who get a rate of less than 5 cents. Reduction of the maximum residence and business rate to 5 cents would entail a decrease of $89,637.21, or 14 per cent, in the company's receipts, assuming that they remain the same as they were in 1910.

In making up the annual cost of service per customer the report took into consideration the various items that enter into production as follows: Operating expenses, $7.44; 8 per cent interest and 8 per cent depreciation and 1 per cent taxes on the investment, $5.10, or a total of $12.54. This is at the rate of 4.5 cents per kw-hour. The cost of energy at the switchboard is $3.40, or 1.2 cents per kw-hour. Residence customers were charged with one-fifth of the peak-load equipment, estimated at $100 each. Using the same rate of interest, depreciation and taxes, it is estimated that the expense of maintaining this is 5.1 cents per kw-hour, or $14 per year.

Electric Development at Portland, Ore.

Announcements of large extensions of their plants have been made by the Portland Railway, Light & Power Company and the Pacific Power & Light Company, of Portland, Ore. The latter company has purchased the Hood River Power & Light Company, Hood River, and the Husum Power Company, of White Salmon, and will expend $1,000,000 in the development of a system for distributing power along the Columbia River for 250 miles. The Hood River plant will be increased from 2500 hp to 3000 hp, and the White Salmon plant will also be enlarged. The two properties are to be connected by cable across the Columbia River. Construction has commenced on a high-tension line between Hood River and The Dalles, which will connect these two places, Mosier and White Salmon, on one circuit. A high-tension line will also be built from The Dalles to Umatilla, 121 miles, which will cross the Columbia to Luzen, extending up that river to Kennewick, where it will meet the new transmission line which is being built from Walla Walla; from Kennewick it will proceed to Priest Rapids, thus connecting all of the company's properties. A considerable amount of the power will be employed in pumping water for irrigation purposes.

The Portland Railway, Light & Power Company expects within the next two years to expend $4,000,000 on its various plants. With construction work now under way, together with that laid out for 1912, the company will by 1914 have a hydro-electric capacity of 100,000 hp. This includes a 15,000-hp plant at Oregon City, a 25,000-hp plant at Cazadero, a 25,000-hp plant at Estacaba, which will be completed this September, and 40,000 additional horse-power on the Upper Clackamas. On the latter river the company will utilize heads at three different points. With all the above-mentioned plants and high-tension connections completed the company will have expended $7,000,000. Eventually it is intended to supply power to a territory within a circle of 100 miles surrounding Portland. In order to insure continuity of service the capacity of the present steam station is being increased yearly and an entire new steam plant has been erected on the east side of the river at Portland.

Chicago Freight Tunnels.

No counterpart exists to the system of freight tunnels underlying the central business district of Chicago and constituting what is sometimes called "Underground Chicago." These tunnels contain narrow-gage railways on which trains of small-platform cars are electrically operated. The system is of unusual interest and has been frequently described, the latest illustrated article on the subject in the *Electrical World* being in the issue of Dec. 23, 1909, page 1519, entitled "Train Operation in Chicago Freight Tunnels." A brief reference to the amount of traffic in the tunnels was given in the issue of March 17, 1910, page 680.

Mr. W. E. Worth, general superintendent of the Illinois Tunnel Company, which operates this unique system, gave an instructive talk on "Transportation Facilities of the Illinois Tunnels" before the Electric Club of Chicago on March 22. Some of the facts brought out by Mr. Worth are summarized below.

The work done by means of these tunnels consists principally in the removal of earth from the excavations for new buildings, the delivery of coal and the removal of ashes from office buildings and the transportation of package freight. For several years excavated material, where suitable, was dumped to make land in the new Grant Park on the lake front, and about 1,500,000 cu. yd. of blue clay was deposited in this manner. At the present time earth from excavations and ashes are taken out eight miles into Lake Michigan for dumping. However, freight transportation constitutes the largest item of the tunnel company's business, and about 100 tons of groceries—to mention one item—are carried through the tunnels for wholesale houses daily. There are four public receiving stations outside of the Loop district, and freight in less than carload lots, if the individual pieces are not too large, is accepted at these stations and taken through the tunnels to the railroad freight warehouses.

Five different kinds of electric locomotives are used. A train consists of a locomotive and ten cars, each 12.5 ft. long and 4 ft. wide over all. The motorman constitutes the entire train crew. Ordinarily one man can handle eight train movements a day, or the equivalent of eighty carloads. One carload is about equal to the load on a one-horse dray. The

largest locomotives are equipped with two 25-hp motors. An overhead trolley is used, and direct current at 250 volts is employed. It is asserted that the public freight-receiving stations receive freight packages which would otherwise require the daily employment of 1200 wagons in the Loop district.

The bottoms of the tunnels are 42 ft. to 45 ft. below the street level, and there are sixty-two miles of tunnels inside the Loop district. There are twelve river crossings and here the tunnels drop down to a depth of 65 ft. below the street level. Three per cent grades are used on the approaches. Watertight doors are arranged at intervals to close the tunnels in case of fire in the buildings on the surface, so that they will not be flooded with the water used to extinguish the fire. Sixty electrically operated pumps are installed to pump seepage up to the sewers, which are on a higher level than the tunnels. The temperature in the tunnels is about 55 deg. the year around. There is some moisture from condensation in summer, so that to those who use the tunnels they seem comparatively warm in winter and comparatively cool in summer.

Traffic is carried on all in one direction, and there is an elaborate network of tracks; practically every street in the downtown business district is duplicated by a tunnel underneath it. It takes a man about three weeks to learn the various routes and a new man is on probation for about six months. The regular motormen get good wages, making from $80 to $100 a month. Electrically operated track switches will soon be installed to save the time necessary to operate the switches by hand. The movement of the trains ventilates the tunnels sufficiently through the shaft connections with the air. Indeed, the current of air from the tunnels is of very material assistance in maintaining a draft for the furnaces of boilers in some of the office buildings having basement connections with the tunnel network. The speed at which trains are operated is about eight miles an hour, and a carefully devised system of signals is operated at cross-overs, as described in the article referred to.

Several members of the club took part in the discussion, and in addition brief remarks were made by W. N. Matthews, of St. Louis; Victor L. Crawford, of New York, and Hugh M. Wilson, of New York.

Central-Station Development on Vineyard Sound.

Active developments are under way for central-station expansion during the coming summer in the Vineyard Sound district of Massachusetts. The electric service in the Falmouth-Woods Hole district is supplied by the Buzzard's Bay Electric Company, and that in the Oak Bluffs-Edgartown section of Martha's Vineyard by the Vineyard Lighting Company, both organizations being controlled and operated by the Carpenter interests of Newton, Mass. The earnings of these properties have increased about 200 per cent in the past two years, under the management of Mr. Eugene Carpenter, who is also prominent in the field of electric refrigeration and who placed the first three-phase induction motor in the country in operation in 1893 in connection with the Sewalls Falls-Concord (N. H.) transmission. The Vineyard Lighting Company is a consolidation of the Cottage City (now Oak Bluffs) Gas Company with the Martha's Vineyard Electric Light & Power Company, and it serves Oak Bluffs, Tisbury, Vineyard Haven, Edgartown and Eastville. The Buzzard's Bay company now serves Falmouth, Falmouth Heights, East Falmouth, Teaticket and Waquoit. The service is now being extended to Quisset and Woods Hole.

The advantages of developing off-peak motor-load business are thoroughly appreciated by the management of these companies and an active campaign is now under way to obtain long-hour patronage. The district served by the two companies has a winter population of about 7000 and a summer population of about 30,000. Residence lighting on the flat-rate basis is being introduced extensively, and the success of this is one of the main causes of the gain in income which the properties have experienced. During the coming open season special efforts are to be made to secure motor-load customers, particular attention being given to the installation of small motors for pumping service in connection with farm irrigation. A large truck garden business is done on the island of Martha's Vineyard and on the mainland in the Falmouth section. The company has already distributed a large number of circulars calling attention to the advantages of electric irrigation and the reliability and cheapness of such service, and has placed many of these circulars in prominent locations in the various towns on the system. Circuits are now being run to the outlying districts to supply the demand for general farm motor service. The company employs the novel plan in this connection of discontinuing its motor service during the hours of the lighting peak, or from half an hour before sunset to 11 p. m. After the lighting load is off, the service on the motor circuits is restored and maintained throughout the rest of the twenty-four hours in summer, when the system provides a twenty-four-hour service from its plants. Energy for motor service is sold from the off-peak circuits at from 5 cents to 3 cents per kw-hour, according to the amount used. On account of the large summer business the peak comes during the warm season and rarely before 6 p. m. Only fan motors are permitted on lighting circuits.

The use of the flat rate in residential lighting has done much to popularize the service of each company. While watt-hour meters are used, their applications are diminishing and practically all the new business is being gained on a first-rate charge. House-lighting rates are based upon the use of the tungsten lamp only, payments being dependent upon the maximum number of lamps in use at any one time. Usually the customer's word is taken as the basis of a contract and in case of any question a Wright demand meter readily settles any difference. A charge of 75 cents per month is made for the first 25-watt lamp connected in a residence, the second and third lamps are billed at 50 cents each per month, and when over three lamps are connected all in excess of that number are charged at the rate of 35 cents per lamp. Under this system each additional lamp beyond three costs the consumer about 1 cent a day, which is a strong talking point with the residents of the territory served by these companies. In the houses so-called "convenience lamps" are permitted in the ratio of 1 to 3—that is, the customer may, if he desires, install extra lamps up to a maximum of twelve. He is not expected to use over one-third of his connected lamps at any one time without special permission from the company. Lamps are purchased by the consumer. The company places them on sale in each case in the stores of prominent merchants practically at cost. The merchant sells with no guarantee and for cash only. At the end of every fortnight he settles with the lighting company and retains 5 per cent commission for handling the sales. This plan enables the consumer to buy lamps at a reasonable rate. The lighting companies maintain a wiring department, which is conducted at a profit, and there are also several local contractors who handle such work. Summer residents desiring lighting service receive the same rates as all-the-year residents, with the exception that the former are required to guarantee a minimum of $9 per season. The meter rates of the companies vary between 25 cents and 15 cents per kw-hour net.

The Vineyard Lighting Company is about to erect a new power plant on Vineyard Haven Harbor, about half-way between Cottage City and Vineyard Haven, the two communities being about two and one-half miles apart. The existing plant is located on the gas-works site near the center of Oak Bluffs and is equipped with simple, non-condensing engines and belted generators. The new station will be provided with greatly improved facilities for coal handling and with compound condensing engines. A wharf will be built for coal reception, the maximum dimensions being 150 ft. x 80 ft., and coal will be

delivered at less expense to the company. The station building is to be a frame structure, 110 ft. long x 42 ft. wide, and it will contain two 200-hp horizontal return tubular boilers with forced-draft equipment, and a station design permitting the use of mechanical stokers and an economizer when conditions warrant their installation. The engine-room equipment will consist of an American-Ball angle-compound and a Harrisburg tandem-compound engine. Condensing water will be drawn from the harbor and the discharge delivered into Lagoon Pond, on the opposite side of the plant. The generating units will consist of a 300-kw, 2200-volt direct-connected alternator; a 100-kw, 2200-volt belted alternator, and a 75-kw and a 62-kw, 550-volt direct-current belted pair of alternators for railway service, all generators being of General Electric manufacture. The plant will operate the Oak Bluffs Street Railway and supply all electric lighting and motor service on the island of Martha's Vineyard. Three transformers are to be provided for future transmission of energy at 6600 volts to distant points which may become centers of electric service application. In connection with the development of electric service in the Vineyard Sound territory much good work has been done in the replacing of kerosene street lamps of about 8 cp by 25 cp series-tungsten lamps, thus revolutionizing the lighting of the quaint old whaling town of Edgartown and providing a much more satisfactory service than was formerly given by oil in many parts of the territory. The local manager of the two companies is Mr. Henry H. Taylor, formerly of the Gardner (Mass.) Electric Light Company. Mr. Charles A. Carpenter is superintendent of the Oak Bluffs Street Railway Company and Mr. Eugene Carpenter is treasurer and general manager of the combined properties.

Electrolytic Corrosion of Iron in Concrete.

Prof. Charles F. Burgess, of Madison, Wis., made a valuable contribution to the literature bearing on the subject of "Electrolytic Corrosion of Iron in Concrete" in a paper with that title read at a recent joint meeting of the electrical section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers in Chicago.

The author reported the results of a study of the protective effect of concrete in preventing electrolytic corrosion of embedded iron structures as made at the University of Wisconsin. The tests seem to show that the resistance of cement or concrete may vary from 30 ohms to several thousand ohms per foot cube. The experiments at Madison were made with a constantly applied e.m.f. of 8 volts. This is a greater difference of potential than the average encountered in commercial practice, but it is a value occasionally found, and 8 volts was chosen as a working pressure which, in a reasonable time, would give measurable results.

Two sets of experiments were made. In each case an iron pipe 2 in. in diameter was embedded in concrete blocks which were placed in jars, the space between the concrete block and the containing vessel being filled with a liquid to form the electrolyte. In the first set of tests this electrolyte was lake water—that is, the ordinary fresh water obtained in Madison—and the tests were continued for 180 days. In the case of the fresh-water tests the cylindrical concrete block was 10 in. in diameter, making the wall of concrete between the iron and the electrolyte 4 in. thick.

The cathode consisted of an iron plate hung from the side of the jar. The jars were connected in parallel, electricity being supplied by storage batteries through a rheostat by which a fairly constant pressure was maintained throughout the test. Frequent measurements were made of current, applied pressure and polarization pressures.

Assuming 1.05 grammes per ampere-hour as the electrochemical equivalent of iron, the theoretical corrosive action of the current was obtained, and by comparison of this value with actual loss of weight the figures on "corrosive efficiency of current" were obtained. Ten samples were prepared for the fresh-water tests, several brands of cement being used. At the end of 180 days the concrete was carefully removed from the pipes and the latter were weighed to show the loss by corrosion due to electrolytic action. A table was given showing that in this fresh-water test the current efficiency of corrosion ranged from 1.05 per cent to 6.88 per cent. The actual loss of iron by corrosion varied from 1.2 grammes to 11.7 grammes.

The second test lasted for sixty-four days and in this case instead of fresh water a 3 per cent salt solution was used to surround the concrete blocks (seven specimens) containing the iron pipes. In this case, however, the cylindrical concrete block was 6 in. in diameter, making the wall of concrete between the salt solution and the metal 2 in. thick. This test was made because it was thought that the pure water used in the other test might not be fairly comparable to the moisture experienced in ordinary commercial practice with reinforced-concrete structures. In this case it was found that large masses of ferric hydrate were formed on the outside of the concrete blocks. The concrete itself, however, was found to have little rust or iron within it. The pipes embedded in it were corroded far more extensively than in the case of the fresh-water test, although the latter lasted much longer, being 180 days, compared with sixty-four days for the salt-water tests. Indeed, the iron pipes were found in some cases to be eaten entirely through. A table given to show the results of the tests with different samples of cement subjected to the salt-solution test show that the current efficiency of corrosion ranged from 40 per cent to 80 per cent, and the loss by corrosion from 105 grammes to 247 grammes. Test results were cited by Professor Burgess to show the polarization pressures, and as those specimens showing the highest polarization pressure exhibit also the greatest current efficiency of corrosion it appears that the polarization pressure may have some relation to the corrosive action. The tests showed that salt in the electrolyte greatly increases electrolytic action. It is not shown that the concrete is affected by the electrolytic action. The speaker believed that the statement that the concrete itself undergoes decomposition has not been proved, at least as far as practical conditions are concerned.

The tests showed that where fresh water is used to moisten the concrete the corrosion per square foot of iron per year is 8 volts and the average amperage of the current applied in the tests ranges from 0.013 lb. to 0.122 lb. for fresh water and from 3.13 lb. to 7.42 lb. for salt water. The figures for corrosion per square foot of iron per year, taking the current applied at the end of the test—and these figures are perhaps the ones of most practical importance—are for fresh water from 0.0036 lb. per square foot per year to 0.41 lb. The corresponding figures for salt water are from 2.70 lb. to 5.85 lb. It must be remembered that all these results were obtained with an applied e.m.f. of 8 volts.

These figures show that under favorable conditions there is the possibility that the iron element in reinforced concrete may be attacked to a serious degree by electrolytic action. It is true that comparatively few failures of reinforced concrete have been traced directly to this cause, but one should not conclude that the day of reckoning has passed. The subject is one of great importance, and one to which increasing study should be devoted. The liability of a difference of potential exists anywhere along the line of an electric railway, not necessarily near the power house. There have been some mysterious failures of reinforced concrete, and one may wonder how far this phenomenon of electrolytic action was involved. In studying the subject field observations are needed as well as laboratory tests. A more general realization of the serious possibilities of electrolytic action may have something to do with the design of future reinforced concrete. For one thing, the continuity of the reinforcing members should be broken as often as possible. In conclusion, the speaker exhibited three specimens of iron pipe which had been subjected to his tests at Madison. In one case, that where the salt solution was

used, the shell of the pipe was completely eaten through, making an opening several inches long.

In opening the discussion Mr. J. G. Wray said that it was some relief to find that the concrete itself may not be disintegrated by electrolytic action, as some investigators have contended. Possibly the age of the concrete or the composition of the aggregate or the porosity of the concrete may have something to do with electrolytic corrosion on embedded iron.

Professor Burgess remarked that apparently if the concrete is made waterproof a positive prevention ought thus to be obtained as a provision against electrolytic action. He believes that the porosity of the concrete has an influence in allowing room for the electrolyte. Mr. W. B. Jackson remarked on the great difference in the results of the tests where fresh water and salt water was used. He made the point that salt is frequently used in mixing concrete in cold weather, and perhaps, with the results of these tests in view, this should not be done. The speaker also commented on the differences in corrosion where different kinds of cement are used, and said these differences were undoubtedly due to the presence or absence of certain ingredients. Tests along this line to determine what these ingredients are might be of further interest.

Mr. R. F. Schuchardt spoke of the value of the work of scientific investigators like Professor Burgess in aiding the accomplishments of engineers engaged in commercial work.

Mr. William Siefert asked what kind of iron was used in the test. Mr. C. A. Keller brought up the subject of cinder concrete, and asked if a coating of pure cement around an iron beam would be sufficient protection where cinder concrete is used in juxtaposition.

Mr. Anderson asked what would have happened in the tests if no electricity had been applied. Mr. G. T. Seely pointed out that it was proposed to use reinforced concrete in the construction of the passenger subway in Chicago, and he advanced the opinion that the insulation of the track rails in the subway should be made very carefully in order to prevent the danger of escaping electricity setting up electrolytic action in the subway structure itself. Mr. O. E. Strehlow said that in building retaining walls, for instance, it might be safer to stick to the gravity wall rather than to use reinforced concrete in view of the possibility of electrolysis.

Mr. W. H. Finley said that it is necessary to use extreme care in making concrete, which should be thoroughly waterproofed. The results of the tests described in the paper show that great care should be exercised also in building reinforced concrete to see that a good mixture is secured, and that the concrete is made as nearly impervious as possible. Mr. Ralph H. Rice asked for further information about the polarization and also about the absorption of the concrete; that is, whether the conductivity was to be considered to be in the moisture in the concrete.

Mr. F. F. Fowle said it would be interesting to know what the current characteristics would be with an applied e.m.f. of, say, 2 volts—what effect it would have on the polarization. He asked if electrolysis affects the strength of the reinforced concrete.

In closing Professor Burgess said that in cinder concrete local electric couples are probably formed by particles of carbon and iron. However, this local electrolytic action is probably slight unless air is admitted. At any rate, the coating of pure cement over the iron should prevent electrolytic action through these local couples. As to the kind of iron used in the tests, he said that it was mild steel, but added that he did not think that the kind of iron used in reinforced concrete makes a great deal of difference so far as electrolytic action is concerned. In relation to what would happen if the tests had been made exactly as they were without the application of electricity, the speaker said that such tests were made, and it was found that fresh water or even salt water produced very little oxidation where no current was flowing. The greatest corrosion was found at a point on the iron pipe near its entrance into the concrete block. The question of polarization is an important one in the study of electrolytic corrosion. Too little attention has been given to it. Another series of tests is now being made at which the applied e.m.f. is 0.5 volt. It is true that if the average pressure is 8 volts, setting up a polarization pressure of 2 volts, then if the applied pressure drops to 2 volts, there ought not to be any electrolytic action until the polarization has decreased below this value. The speaker believes that the current is carried through the concrete by the moisture in it; in other words, by the electrolyte. It is purely a question of the electrolyte.

Electrical Resistance of Wood Treated with Preservative.

The American Railway Engineering Association's committee on wood preservation, of which Prof. W. K. Hatt, of Purdue University, is chairman, reported at the recent Chicago convention that there are now more than seventy wood-preserving plants in the United States. A number of the large steam roads possess expensive plants fitted to handle large quantities of timber in a very efficient manner. Nearly all treated crossties used by steam railroads are prepared in closed cylinders permitting the application of pressure and designed to secure a heavy absorption of the preservative. The principal preservatives used were creosote oil and, to an almost equal degree, a solution of zinc chloride. Many ties are treated with an emulsion of creosote oil and a solution of zinc chloride, and one road treated large quantities of its ties with a heavy injection of crude petroleum. Other preservatives are also used. The electric railroads own but a few cylinder treating plants and are generally obliged to purchase treated ties or to use some less expensive method of treatment, such as dipping the ties in a bath of the preservative. Many different preservatives are used in this manner.

An interesting appendix to the report related to the electrical resistance of timber as affected by treatment with preservatives. It is based on an investigation made by Mr. J. T. Butterfield, of the School of Electrical Engineering at Purdue University, in the spring of 1910. The results tended to establish the fact that, although timber is ordinarily classed with the nonconductors, and when dry and well seasoned it has a very high dielectric strength and practically infinite resistance, yet when green or moist it becomes a kind of electrolytic conductor of comparatively low resistance. The treatment with zinc preservatives has the simple effect of producing in the wood a stronger electrolyte and hence a better conductor of current. All of the data obtained confirmed the view that the conductivity of wood is due primarily to the presence in the pores of an electrolyte formed by an aqueous solution of the salts found in the natural timber, or of these salts and others artificially introduced.

The investigation related primarily to ties, but the conclusions reached may have some bearing on the preservation of poles.

Importance of Fundamentals in Engineering Education.

In an address given at a weekly luncneon of the Electric Club of Chicago Prof. E. H. Freeman, professor of electrical engineering in Armour Institute of Technology, Chicago, dwelt on the fact that engineering education should tend toward instruction in fundamentals rather than in specialization. His subject was "Electrical Education," and he showed how the demand for electrical education was met first in the colleges by physicists, although at the present time the courses in electrical engineering bear practically the same relation to the teaching in physics as do the other engineering courses.

In selecting material for the course in electrical engineering two requisites must be borne in mind. These are, first, the

supplying of information to students, and, second, training their ability to solve problems in engineering by means of the information which has been obtained. The student is apt to think that the first requisite is of primary importance, while the instructor believes that the second is of greater significance. The attempt is therefore made to give the student what he thinks he wants and also what he really needs. The subjects in the course must be selected, therefore, with these two ends in view.

But to meet fully both requirements of the electrical course would require a greater amount of material and more time than are available ordinarily. So those subjects must be selected which the student would have the greatest difficulty in mastering by himself or without the assistance of the instructor and the aids in teaching which are presented in the school. This leads to the consideration that careful attention must be given to theory as applied in practice. Thus considerable time must be given to the mathematical theory of electrical calculations and investigations, because the college is particularly the place where the student is helped over the difficult steps in this study. Practical men often regret their lack of training in theory, and it is the province of the engineering school to deal largely with the study of the underlying theory. Steinmetz was quoted as saying that the electrical engineer gives only four years to theory against perhaps forty years to practice.

Three well-defined classifications of electrical engineering may be made. These relate to power and heavier currents, to the telephone and lighter currents and to the various aspects of illumination and electric lighting. The student might specialize in relation to one of these branches if he knew just where his work would lie in after life, but as a matter of fact it is not desirable to carry specialization very far in college. The work in the engineering school should dwell especially on the fundamental relations underlying engineering work of a given character, as civil engineering, mechanical engineering or electrical engineering. Indeed, it is perhaps advisable not to give too much attention to even these broad lines of demarcation, except such as are necessary in order not to offend too deeply the susceptibilities of the student who, for instance, insists that he wants to study electrical engineering and not mechanical engineering. At Armour the endeavor is to make the electrical engineering course rather general in its nature. Students can specialize after taking the general course if they wish.

Instruction is given by means of lecture and recitation work and by laboratory and shop work. Professor Freeman referred briefly to the plan which has been recently tried of giving the shop work in commercial establishments outside the school, thus interspersing practical shop work in outside factories with instruction in school. He said that it was too early to pass final judgment on this plan. However, he pointed out that this mixed form of instruction would not be so valuable for a man who afterward engaged in plant operation or consulting work as it would be for the one who later went into manufacturing.

As to efficiency of educational institutions, the speaker said that it was more important that they should be efficient educationally than from the business side—that is, in making students themselves more efficient rather than in seeking to use the buildings and equipment of the school to the highest degree of efficiency. An exact comparison cannot be drawn as to efficiency between an educational institution and a commercial organization. As education is a development coming from within, the student is not working for the professor, although he sometimes thinks he is; he is working for himself. On the contrary, the employee of a business house finds his highest efficiency in working for his employer. There should be cooperation between instructors and engineers. In closing Professor Freeman asked not only for the moral support but the conscientious criticisms of his hearers in the effort to make engineering education more efficient.

Prof. P. B. Woodworth, of Lewis Institute, was called on and said that he was pleased with what the speaker of the day had said about specialization in engineering education. There is every evidence that specialization is carried too far in college work. The demand is for good, positive groundwork in general physics. Professor Woodworth quoted facetiously a rough-hewn declaration made at a recent conference in classic Boston in relation to engineering education. This dictum is to the effect that "Them as knows does; them as don't know teaches."

Telephony and Telegraphy Under Interstate Commerce Commission Control.

As a result of arguments presented on Dec. 7, 1910, before the Interstate Commerce Commission relative to the control of the commission over telegraph and telephone companies, the commission has made public its view that when "two or more lines are connected so that a person within one state, territory or district of the United States talks with a person at a point without such state, territory or district of the United States, or so that a message is transmitted directly from a point within a state, territory or district of the United States, to a point without the same, the transmission of messages in this manner constitutes interstate commerce" and brings all of the participating lines within the control of the commission.

Telegraph and telephone companies coming under the above control are required to make reasonable and just rates and charges for the transmission of interstate messages, are forbidden to make discriminatory rates and are required to keep their accounts and memoranda in the manner specified by the commission, to which they must make reports at stated intervals.

St. Louis Valuation and Rates.

A statement regarding the report of the St. Louis Public Service Commission in relation to the valuation of the property of the Union Electric Light & Power Company has been made by Mr. Alten S. Miller, president of the company. Mr. Miller said that the findings of the commission were naturally very disappointing to those connected with the company, and that many large expenditures on the property had been disallowed in spite of the fact that vouchers were produced showing that the expenditures had been made properly. As large sums had been spent in building up the business it seemed only proper that the amount thus spent should be allowed as part of the cost of the property.

While the effect of the commission's action had been to reduce the value of the property $14,000,000 below the actual cost as shown by the books, Mr. Miller said, the most serious decisions were those in relation to the schedule of rates. The commission found that the company was justly entitled to what it is now earning, but at the same time it recommended that maximum rates be cut down. This seemed to Mr. Miller to be utterly inconsistent unless it was the policy of the commission to compel an increase in the rates on commercial and industrial consumption, a policy which would certainly be bad for the city generally.

Although Mr. Miller did not question the sincerity and good intentions of the commission, he did feel that simple justice had not been done to the Union Electric company. Detailed and complete records were submitted to prove that the business had up to this time not earned nearly what the commission now says the company was entitled to earn. An endeavor was made to make plain the policy of the company to improve and expand its facilities beyond immediate needs and regardless of present profits, looking to the future growth of St. Louis and the business to obtain ultimately the just return on actual investment, but the commission, Mr. Miller felt, had ignored this view and had arrived at conclusions which must necessarily hamper future development.

Mr. Miller stated that in determining the rates the commission assumed that it cost a certain definite amount to take care

of each customer, large or small. This it called the "customer's charge." The next element was the cost for each kilowatt used at the time of the heaviest load on the company's station in December. This element the commission called the "investment charge." The last element of cost covered the actual generation and some portion of the delivery of the electric energy and varied with the amount generated. This the commission called the "manufacturing charge."

After stating that these three elements should be considered in determining an equitable rate, the commission, Mr. Miller added, entirely eliminated the investment charge in reaching the conclusion that 9½ cents was a fair maximum charge. It could quite as consistently have omitted the customer's charge and have claimed that a much lower rate than 9½ cents was proper and sufficient. The customer's charge used by the commission in reaching its rate was approximately $11 per annum. In its analysis of the investment charge it showed that the investment charge per kw-hour was $82 per year, and that the average residence customer used 157 watts and, therefore, cost the company $12.87 per annum in addition to the $11. This customer would not meet his portion of the actual cost of service unless he paid $24 per annum in addition to the manufacturing cost of the energy used, which, however, was comparatively small. If the provision in the ordinance making the maximum monthly charge 50 cents was allowed to stand this would involve an average loss of $1.50 per month on each customer paying the minimum rate.

Mr. Miller stated that the commission was wrong in saying that the residence rates are high and that it had reached this conclusion by ignoring the results of its own analyses. If the pending ordinance was passed much constructive work in establishing the uniform system of rates in St. Louis would be destroyed and for several years there would be the same dissatisfaction and confusion that resulted from the rates established in 1907, to the serious disadvantage of the city and everyone doing business therein.

Mr. Miller, in a communication to the Municipal Assembly on March 27, specified a number of objections and exceptions to the report of the commission. The reasons which he gives are, in part, as follows:

1. A member of the commission made the investigation as engineer to the commission and, therefore, was not in position to review the report in a judicial capacity.

2. Hearings of the commission were not open to the public as required by the ordinance, and were in part conducted in secret and were not open either to the public or to the company.

3. The commission examined witnesses in secret and failed to submit them to the public investigation for examination or cross-examination.

4. It was influenced in its findings and conclusions by ex parte statements made in secret by witnesses not submitted to examination or cross-examination.

5. The findings and conclusions of the commission are in conflict with the conclusive testimony of witnesses publicly examined before the commission and are not supported by the record of the proceedings.

6. The findings of the commission fail to support and are, as a matter of fact, in conflict with its recommendations.

7. The conduct of the entire investigation by the commission was in conflict with the fundamental principles of law, the long-established and recognized policy of the government and the recognized rights of individuals under it, in that it was in part a secret investigation in which it was attempted to affect the rights and property of citizens without affording to them an opportunity of being properly heard or of examining or cross-examining witnesses adduced against them or of inspecting the record of the investigation.

8. The findings of the commission regarding the cost and value of the property of this company are erroneous and are not in accord with the evidence or the facts.

On account of the irregularities thus averred the company asked that the report be referred back to the commission with instructions that the investigation be reopened and that the company be allowed the fullest opportunity to cross-examine all witnesses and to meet all other testimony which the commission used in forming its report.

The bill recommended by the Public Service Commission making the maximum rate 9½ cents per kw-hour was passed by the Council on March 28 and was sent to Mayor Kreismann for signature.

Ohio Public Utilities.

The Winters public utility bill will come up in the Ohio House of Representatives for action during the first week in April. Judge Winters has announced that amendments must be made that will replace important provisions that have been removed since its introduction. Representative L. K. Langdon will offer a number of amendments and many members of the House have announced their intention of not supporting it unless they are adopted. As it stands at present the bill applies only to telephones so far as actual supervision is concerned.

The Yount telephone bill has been before the Senate committee on railroads for some time and so far it has refused to report the bill out for action. Senator Yount demanded that the bill be reported in March, but the excuse that the Winters bill would come up first for consideration in the House was given. Many of the telephone companies favor the Yount bill to the exclusion of the public utilities bill.

Massachusetts Legislative News.

An unexpected turn occurred last week in the House in connection with the discussion of the Henebery bill providing that municipal authorities may grant limited franchises to street-railway companies for the carriage of freight and express matter. By a vote of 107 to 61 the House set aside the adverse report of the committee on street railways upon this measure and placed the bill in the calendar for further consideration. Chairman Washburn, of the committee on railroads, said that if the bill should pass it would completely overturn the policy of the State, which for many years has granted perpetual franchises to street railways, the companies having the right to appeal to the Railroad Commission in case the local authorities refuse their petitions for the right to handle this class of traffic. The Henebery bill takes the power of franchise grant away from the commission except in cases where obstruction occurs to the establishment of through lines of express service.

The committee on public lighting has sent in an adverse report on the bill requiring electric light companies to furnish energy to properly qualified consumers without a contract. A bill has been introduced into the Senate to provide for post-mortem examinations of the bodies of persons electrocuted in accordance with the sentence of a court. The committee on metropolitan affairs has reported no legislation necessary on that part of the report of the Joint Commission on Metropolitan Improvements which discussed the question of steam railroad electrification within the Boston district. The commission voted by a narrow majority against immediate legislation banishing the steam locomotive, but several bills are pending which deal directly with the electrification problem. At recent hearings it has become apparent that if the New York, New Haven & Hartford Railroad tunnel is authorized under Boston Harbor by the present Legislature a beginning in electrification will certainly be made in that connection. The disposition to require the railroads to electrify the lines in the entire metropolitan district bids fair to yield to a program in which some of the more important lines will first be equipped for electrical operation, with extension of the system as fast as practicable to branch lines. The committee on public lighting has reported that the resolve ought not to pass which provides for an investigation of the price of electricity and the

rate of dividends to stockholders of electric light companies. There is a general belief that this legislation is unnecessary in view of the publicity of returns on file with the Gas & Electric Light Commission. The committee on public lighting has sent in an adverse report on the bill providing that the readings of gas and electric meters shall be furnished to customers by companies. The committee on street railways has reported leave to withdraw the bill providing for the revocation of street railway franchises in certain cases. The committee on taxation has reported favorably upon the bill extending the exemption of property subject to inheritance taxation to cover shares of stock in any railroad, street railway, telephone or telegraph company incorporated under the laws of the State and also of some other State or country.

California Conservation Measures.

On March 22 the Senate of the California Legislature passed the Assembly bill creating a California Conservation Commission and appropriating $100,000 for its work in the next two years, and the bill will be given to Governor Johnson, whose signature is considered certain. The commission is to consist of five members, to be appointed by the Governor, and to serve without compensation beyond having their actual expenses paid. The commission is to gather data and information concerning forestry, water and water-power, electricity, mines and mining, mineral and other lands, dredging, reclamation and irrigation, and is to advise the next Legislature what laws should be passed.

Following the bill the Senate passed four additional conservation measures. The most important of them is a bill which regulates and limits the appropriation of water for the generation of electricity, fixes the terms and conditions for such appropriations, provides for licenses to run for twenty-five years and reserves to the State the right to fix the rates of compensation for which electricity shall be furnished and to impose charges for the use of appropriated water, and provides for a board of control to consist of the Governor, State engineer and three other persons, whom the Governor shall appoint.

An Assembly bill introduced by Assemblyman Schmidt, of San Francisco, has been passed by the Senate amending a section of the civil code which now requires corporations to furnish gas and electricity on demand so as to include steam and heat, which must be supplied to householders residing not more than 100 ft. from the mains on application and payment. The Senate passed also an Assembly bill introduced by Assemblyman Coghlan, of San Francisco, empowering municipalities to grant franchises for laying pipes to carry steam heat under high pressure for distribution and sale to inhabitants.

Massachusetts Commission News.

The Massachusetts Gas & Electric Light Commission gave a continued hearing on March 20 at Worcester upon the petition of Mayor James Logan for a reduction in the price of street lighting as charged by the Worcester Electric Light Company. Mr. William D. Marks, of New York, consulting engineer for the petitioner, was re-examined. He stated that he figured the cost of street lighting in Worcester by estimating the cost of energy delivered at the lamp, assuming the present value of the street-lighting equipment, allowing 7 per cent depreciation and 5 per cent profit. The cost of energy was estimated on the basis of eleven hours' daily use of the connected load. Mr. Marks said that in 1910 the municipal arc system of Worcester, which is a magnetite installation, required a station equipment of about 348 kw. He felt that it would be necessary to make an appraisal of the property in order to make a proper determination of the cost of street lighting, but admitted that there was room for much difference of opinion as to depreciation values. Mr. Marks figured the cost of energy at the lamp terminals to be 1.38 cents per kw-hour, but admitted in response to inquiries that this cost was based upon the operation of the entire connected load of the station for a period of eleven hours per day—a condition not realized in practice. He was unable positively to cite any specific central station in the world which is delivering energy at the terminals of street lamps at a cost as low as 1.38 cents per kw-hour, taking all charges into account. It was shown that the average cost of energy was 3.4 cents per kw-hour as a result of questions by members of the board. Chairman Barker pointed out that the latter figure was based on actual facts of cost and output, and that the former figure was based only upon assumed facts of cost and output having no real existence. General Schaff, of the commission, said that in his opinion the companies would never satisfy the public until they bring their prices down to a leved, not an absolute level, but as nearly so as possible, following a somewhat extended discussion of early methods of charging for energy.

Mr. Fred H. Smith, assistant superintendent, testified that the company estimated the present value of its municipal lighting equipment to be $436,520, compared with Mr. Marks' estimate of $290,000. The items were as follows: (a) Lamps, machinery, poles and fittings, $42,716; (b) steam plant, $10,465; (c)) buildings and real estate, $7,349; (d) 1,279,971 ft. of No. 6 B. & S. copper wire, $161,256; (e) 100 miles of single ducts, $214,804; total, $436,520. Mr. Smith stated that item "a" included about 10 per cent of the equipment of the station (station equipment used for no other purpose than street-lighting service) and arc lamps. There are now about 900 arc lamps in service in Worcester. The structural cost of the municipal arc-lamp equipment, less 40 per cent depreciation, came to $20,093. Mr. Smith stated that the depreciation on a 4-amp magnetite arc lamp is about $2 per lamp per year. An allowance of 7 per cent was made for the depreciation of the generator equipment and about 5 per cent on the building. The company estimated the present value of arc-circuit wire placed underground at about 12 cents per foot, the average price new installed being from 17 cents to 18 cents per foot for No. 6 wire. About 33,000 lb. of weatherproof wire of this size was also included at a present value of 12 cents and about the same length of No. 6 rubber-covered wire at 10 cents per foot. The hearing was continued to April 7, when the company will present further evidence bearing upon the cost of magnetite lighting.

The commission has granted the petition of the Greenfield Gas Light Company for authority to issue 700 shares of additional stock at the par value of $50 per share to meet the cost of additions to the plant.

The Railroad Commission gave a hearing at Boston on March 31 on the petition of citizens of Holliston for a reduction in fares on the Milford & Uxbridge Street Railway. The petitioners desired that the present fare of 10 cents between South Framingham and Holliston be cut to 7 cents. The company's response pointed out that the distance is six miles; that similar rates are charged by itself and other street railways in central Massachusetts; and that even if the present earnings are maintained until the end of the fiscal year in June the company will be able to pay a 6 per cent dividend only by refusing to set aside any money for depreciation. Wendell Williams, Esq., counsel for the company, stated that no conditions have arisen since the board's adjudication of last fall in favor of the increased fare that would warrant a finding that the rate is excessive. He pointed out that the company has about thirty-six miles of track in operation, and said that there should annually be put by at least $25,000 surplus in order that the road may be properly maintained with modern standards of equipment. Wages have increased on the road in the past year from 22.5 cents per hour to 25 cents per hour, and the transportation expense has consequently gone up by about $8,000. An average dividend of only 1.83 per cent has been paid on the stock in the past six years. A strong point was made for the company by the presentation of petitions signed by the selectmen of every town in the territory except the municipalities named above urging the commission not to order a reduction, on the ground that such an action would be an unfair discrimination against the towns in which the fares remained unchanged. The board took the case under advisement.

The Railroad Commission gave a final hearing on April 3 upon the petition of Mayor Fitzgerald, of Boston, for a transfer investigation on the Boston Elevated system. Mr. C. S. Sergeant, vice-president of the company, testified at length regarding the difficulties of establishing a consistent free-transfer system on a large urban electric railway. He pointed out that if the company issues transfers permitting passengers to ride in a direction opposite to their original course, danger exists of excessive rides being taken on a single fare. In Boston this policy would lead to the company's giving a forty-mile ride for 5 cents, which would obviously be an intolerable situation. It is probable that the company will make an attempt to install transfers of limited validity as to distance in the present case, provided the operating difficulties are not too great. A conference with this object in view will be held by the board in connection with the company and the petitioners.

New Jersey Commission News.

The Board of Public Utility Commissioners for the State of New Jersey has approved the agreement of merger and consolidation of the Shore Electric Company, Sea Bright Electric Light Company and the Citizens' Light & Fuel Company of South Amboy, forming the Shore Lighting Company, the agreement having been entered into March 21, 1911, and has also approved the proposed issuance, sale and delivery of $400,000 5 per cent mortgage gold bonds by the Shore Lighting Company at the par value thereof.

The board has approved ordinance of the township of Little Egg Harbor granting a franchise to the Ocean County Gas Company and a resolution of the Ocean County Board of Chosen Freeholders granting the company permission to construct gas mains along the Shore Road, in Ocean County, from Toms River south, through the townships of Berkeley, Lacey, Ocean, Union, Stafford, Eagleswood and Little Egg Harbor.

Maryland Commission News.

The Maryland Public Service Commission has received a petition asking that the Hyattsville Gas & Electric Light Company be required to reduce the price of gas from $1.50 to $1 per 1000 cu. ft. The petition will be referred to the company in question for a reply before any action is taken.

The commission last week signed an order granting authority to the Washington, Baltimore & Annapolis Electric Railway Company, in accordance with the company's reorganization plan, to transfer its franchises and physical properties to the new corporation and to issue stock for the discharge of obligations incurred by both. In addition to permission to take over the properties of the Anne Arundel Electric Railroad Company, the Washington, Baltimore & Annapolis Railroad asks that it be allowed to issue $3,000,000 of 5 per cent bonds at par, $1,369,512.75 par value of non-cumulative preferred stock at 6 per cent and $1,500,000 common stock of the Anne Arundel company in payment of obligations. A trust mortgage of $7,500,000 from the Washington, Baltimore & Annapolis to the Cleveland Trust Company was filed last week for record. It covers all of the property, rights and franchises of the company, and is to secure the issue of an equal amount of first-mortgage gold bonds dated March 1, 1911, payable March 1, 1941, and bearing 5 per cent interest. The mortgage states that $5,000,000 of the bonds will be issued immediately to acquire the Anne Arundel road. The remaining $2,500,000 will be used for enlargements, improvements and extensions.

New York Commission News.

In connection with the investigation which John N. Carlisle is making of the New York Public Service Commission, First District, at the request of Governor Dix, announcement was made that a public hearing would be held at the Engineering Societies Building, New York, on April 4. Mr. Carlisle announced that the hearing had been called to afford an opportunity to any who desired to make complaints regarding the work of the commission. He had received a letter on the subject from F. W. Whitridge, receiver of the Third Avenue Railroad, which he would make a part of the record. Mr. Whitridge's letter said in part: "As receiver of the Third Avenue Railroad I have been attacked, regulated and harassed by the Public Service Commission of the First District in a way which is explained in my replies to the communications of the commission. All of these have been printed and are public property. I have never taken the initiative in attacking the commission at any time, and practically the whole of my writings in respect to them are in the nature of replies. I do not care to take the initiative now, but if there is any assistance which I can give you I am entirely at your service." Mr. Carlisle then asked if any of the few who were present wished to appear. As there was no response he said he would wait a few minutes before adjourning the hearing. As no one appeared to testify Mr. Carlisle made a brief statement regarding the progress of his work. He said that he had been directed by Governor Dix to make the investigation into the affairs of the First District commission. He had talked with the employees in order to become familiar with their duties and had examined the work of the commission. An auditor from the Second District commission was now making an investigation of the books of the First District commission. The work of examination would be continued by Mr. Carlisle until its completion, when a report would be made to the Governor.

Wisconsin Commission News.

The Railway Commission has authorized the Milwaukee Northern Electric Railway Company to issue $1,500,000 par value of 5 per cent bonds to be secured under the terms of a mortgage executed by the company to the First Savings & Trust Company, of Milwaukee. The bonds are to be issued for money only and for not less than 75 per cent of the par value. The company has been empowered also to issue 4000 shares of first preferred cumulative stock, of the par value of $100 per share, and 6000 shares of second preferred non-cumulative stock, of the par value of $100. The stock is to be sold for money only and at not less than par. The stock and bonds are to be sold for the purpose of supplying the company with funds with which to purchase and retire an outstanding bonded indebtedness of $2,500,000. The total assets of the company are given as $3,500,000.

The Eastern Wisconsin Railway & Lighting Company, of Fond du Lac, has been authorized to issue $76,000 par value of its 5 per cent twenty-year first-mortgage gold bonds, of the par value of $1,000 each, to be secured by the refunding and extension mortgage executed by the company to the Milwaukee Trust Company, of Milwaukee. The funds to be derived, in so far as possible, are to be used to pay the obligations incurred in making additions and extensions to the system, and also to reimburse the reserve, working capital and surplus accounts for the funds taken from these accounts and used in paying for the extensions and additions.

The commission has received a petition signed by members of the Commercial Club, of Superior, Wis., in which it is alleged that the rates for electric, water and gas service now being charged by the Superior Water, Light & Power Company are excessive and discriminatory. The petitioners contend, among other things, that the city is receiving electrical energy at a lower rate than the private consumer for the same kind of service; that the revenues from lighting and motor service are more than sufficient to pay a reasonable return upon the property properly devoted to this branch of the service, provided ordinary care and business management are used in the conduct of the business. The petition prays for a general reduction in rates and the removal of all discrimination between city and private consumer.

The Manitowoc Electric Light Company has requested the commission to determine upon a reasonable rate for motor serv-

ice in cases where a varying quantity of power is used for ten hours a day or more. The company objects to the present schedule for the reason that it offers the same rate regardless of the number of hours that the power is used daily. This contention is in accord with the commission's doctrine to the effect that special consideration should be given "off-peak" and "long-hour users" in formulating a rate schedule.

The Burkhardt Milling & Power Company has applied to the commission for authority to abolish its present meter rental of 25 cents per month and to substitute therefor a minimum bill, the amount of which is left to the commission to determine. The village of Sun Prairie, which recently acquired the plant of the Sun Prairie Electric Light Company, by the exercise of its option to purchase granted by the Public Utilities law, has requested the commission to investigate conditions in Sun Prairie and to recommend a schedule of rates for electric lighting and motor service.

The City of Baraboo has concluded to install a municipal lighting plant and has applied to the commission for authority to do so. Inasmuch as the Baraboo Lighting Company is now doing business under an indeterminate permit granted by the commission it will be necessary for the city to show cause why such a municipal plant should be installed. The municipality rests its claim chiefly upon the fact that the city water-works plant is operated by water-power and that there is a surplus of power available which might be utilized in generating electric power for the city's use at a comparatively small cost. The commission has taken the matter under advisement.

Canadian Hydroelectric Commission News.

At a meeting of the commission at Toronto on March 30 it was decided to extend the Niagara power transmission line from St. Thomas west to Windsor, a distance of 128 miles, at an approximate cost of $2,000,000. The extension will depend upon whether favorable contracts can be made with the City of Windsor and the distributing company. Twenty-three municipalities along the line of the proposed extension have been anxious to secure power for some time and the majority of them have authorized the civic authorities to enter into contracts with the commission for an aggregate amount of 12,000 hp. Windsor stands ready to take about 15,000 hp, provided arrangements can be made to export the excess over that used by the city. The principal portion of the power to be supplied to Windsor will be required for the Detroit River tunnel and terminals there, the amount necessary for that purpose being estimated at 7500 hp, while for the use of the municipalities of Windsor and Walkerville 3000 hp will be taken. If the necessary arrangements are made Windsor will be allowed to export any excess power under a contract that makes the power returnable when required in the Province of Ontario. This contract may be terminated and the power kept within the province at any time after five years, upon one year's notice. The City of Windsor will be required to secure a Dominion license to export power, but it is not expected there will be any difficulty in obtaining the consent of the federal authorities for this purpose.

In the meantime a proposition has been made by the Sandwich, Amherstburg & Windsor Electric Railway Company to supply electricity to the City of Windsor from its new power plant at a rate estimated by the company to be equivalent to $35 per horse-power per annum. The matter was brought to the attention of the City Council at a meeting on March 27 in the form of an offer to deliver to the city sufficient energy at 2200 volts for 350 street lamps at a rate of 1.56 cents per kw-hour, the energy being furnished from the street railway's three-phase, 60-cycle system. A condition attached to the proposition was that the city should enter into a ten-year contract, subject to cancellation on six months' notice, not to be given, however, until after three years from the time the contract begins. The proposition was referred to the power committee, which is to report during the following week.

The municipalities of Napanee, Kingston, Lansdowne, Brockville, Lyn, Prescott, Cardinal, Morrisburg and Athens have been informed by Hon. Adam Beck that the commission is not prepared now to give the prices at which power would be supplied to these municipalities, but that the towns in eastern Ontario would receive power on as favorable terms and at as favorable prices as the towns and cities in western Ontario which are being furnished Niagara power. The whole matter, including prices, will be laid before the municipalities at a meeting to be held at either Brockville or Kingston during the next week.

The commission has closed a contract with the Simcoe Power Company for the supply of 1600 hp to be transmitted by the commission to Penetanguishene, Midland and Waubaushene in northern Ontario.

The formal celebration of the arrival of Niagara power in Toronto over the hydroelectric transmission lines is arranged to take place on May 2. It was decided that the city hall should be made the central feature in the scheme, which will be elaborately decorated in honor of the event. A public reception will be tendered by the city to the members of the Hydroelectric Commission, members of the Ontario government and members of the Western Ontario Power Union. After the banquet Sir James Whitney, Premier of Ontario, will press the button to start the illumination of the hall. Mr. Philip W. Ellis, the wholesale jeweler, has been selected by the Board of Control as the city's nominee to the commission appointed to manage the hydroelectric system of Toronto. The Ontario government through the Hydroelectric Commission appoints one member, and the third will be the Mayor for the time being, who serves without salary. Each of the other commissioners will receive a salary of $4,000 per annum and hold office for two years. Mr. Ellis was a member of the original Ontario Power Commission appointed by the Union of Western Ontario Municipalities in 1905, which first inquired into the possibilities of utilizing Niagara power.

The Galt, Preston & Hespeler-Berlin Railway is the first railway in Canada to use Niagara Falls power, the connections having been made and the power turned on at the company's own transformer station at Berlin on March 27. The company's passenger and freight trains were run with noticeably improved smoothness and on schedule time, the freight trains, consisting of twelve heavily laden cars, being hauled by specially constructed electric locomotives, said to be the first of their kind used on a Canadian railway. Hon. Adam Beck, chairman of the commission, came from London for the occasion and was met by representatives of Galt, Berlin and Waterloo and Chief Engineer Sothman, of the commission. After the turning on of the power a trip was made over the line in a special car.

On March 31 Chairman Hon. Adam Beck announced at London that the Power Commission would send two or three engineers to Europe at the end of April to study the electrical situation there. They will be accompanied by an expert who will make a special investigation of electricity as applied to farms, and Mr. Beck will also join the party in May.

CURRENT NEWS AND NOTES.

Chicago Electrification Committee Organized.—Permanent organization of the Association of Commerce committee on electrification of steam railroads in Chicago has been effected. Former Judge Jesse Holdom is chairman, Mr. T. E. Donnelley vice-chairman, and Mr. Frederick W. Rawson secretary of the association.

Columbia Electrical Engineering Society.—At a meeting of the Electrical Engineering Society of Columbia University, to be held on April 7 at 8:15 p. m. in the Engineering Building, Mr. A. H. Armstrong, of the General Electric Company, will deliver a lecture on the subject of recent developments in electric traction. This meeting is open to the public.

Missouri Convention Next Week.—The annual convention of the Missouri Electric, Gas, Street Railway & Waterworks Association will be held in St. Louis April 13, 14 and 15.

Los Angeles Desire for N. E. L. A. Convention in 1912.—It is reported that Los Angeles will make a strong effort to secure the 1912 convention of the National Electric Light Association. The Chamber of Commerce of that city has taken the matter up, and it is said that it will make a decided effort to obtain next year's convention.

New Gas Company in Southern California.—Following the incorporation of the Southern Counties Gas Company of California comes the announcement that the Southern California Edison Company, Los Angeles, has transferred to the new company its gas properties at Santa Ana and Whittier, Cal. The general offices of the new company will be at Santa Ana. Mr. C. S. S. Forney is president.

Society of Wireless Telegraph Engineers.—The Society of Wireless Telegraph Engineers will hold a regular monthly meeting in the Walker Building of the Massachusetts Institute of Technology on April 3 at 8 p. m. At this meeting the future work and plans of the society will be discussed. The president of the society is Mr. Fritz Lowenstein, of New York City; vice-president, Dr. Louis Cohan, Washington, D. C., and secretary, Mr. E. M. Moore, 39 Trinity Place, Boston, Mass.

Hat Creek Farmers' Demand for Damages.—About sixty farmers using water from Hat Creek, near Redding, Cal., have brought suit against the Shasta Power Company (Sacramento Power Company successor) alleging damages amounting in the aggregate to $255,000. The defendant utilizes the water of Hat Creek to generate electricity, which is transmitted to Redding, Chico and other towns. The farmers allege that their riparian rights have been impaired by the abstraction of water without due authority of law.

International Railway Fuel Association.—The third annual convention of the International Railway Fuel Association will be held in the Hotel Patten, Chattanooga, Tenn., on May 15-18, 1911. The program includes six papers, mainly relating to coal and oil as locomotive fuel, although one relates to "Fuel Investigations Under the Bureau of Mines," by Dr. J. A. Holmes, director of the United States Bureau of Mines. Mr. W. C. Hayes, Erie Railroad, New York, is president of the association, and Mr. D. B. Sebastian, Rock Island Railway, Chicago, is secretary.

Arkansas Association of Public Utility Operators.—At a meeting of the executive committee of the Arkansas Association of Public Utility Operators held in Little Rock, Ark., March 15 it was decided to hold the annual convention of the association in Little Rock on May 3, 4 and 5. The papers presented will cover public-utility operation of railways, gas, electric light, natural gas and water. The chairman of the committee for the entertainment of delegates and guests is Mr. D. A. Hagarty, vice-president and general manager of the Little Rock Railway & Electric Company.

Turin International Congress.—The American Institute of Electrical Engineers has appointed a special committee to attend to the representation of the Institute at the International Congress of the Application of Electricity to be held at Turin, Italy, from Sept. 9 to 20, 1911. The members of the committee thus far appointed are Chairman, J. W. Lieb, Jr., past-president of the A. I. E. E.; Dr. A. E. Kennelly, president of the United States National Committee of the International Electrotechnical Commission; Dr. S. W. Stratton, director of the National Bureau of Standards, and Mr. T. C. Martin, executive secretary of the National Electric Light Association.

Electricity in California Oil Fields.—The San Joaquin Light & Power Company, Fresno, Cal., has reached Taft with its transmission line from Bakersfield through the West Side oil fields and will soon be in position to supply the operators with electrical energy to operate their oil drills. The new line will form a loop from Fresno to Bakersfield, passing through the Coalinga and Kern River oil fields. Substations at Famosa, Wasco and other points are contemplated. It is said that the company will spend $250,000 on its new plant in Bakersfield, largely increasing the steam-power plant equipment. This will insure the steady supply of energy necessary for the operation of the plants in the oil fields.

Fort Frances Power Situation.—The efforts of the town of Fort Frances (Ont.) to place restrictions regulating the power development at that point by the Ontario & Minnesota Power Company, as previously noted in these columns, culminated in the passing of a bill through the Canadian Parliament on March 27 which specifically provides that the Public Works Department shall have authority to determine the character of the power development at Fort Frances. After considerable discussion by various members, both for and against the measure, Sir Wilfrid Laurier suggested an amendment under which it is provided that 50 per cent of the power now or in future developed shall always be available on the Canadian side, and, with this change, the bill was finally approved.

An All-Electrical House.—One of the comparatively few residences in this country to be wired complete for electric lighting, cooking and heating is the house of Mr. A. Lamborn, the manager of the famous all-electrically equipped Hotel Stanley and Stanley Manor, at Estes Park, Col. The house, an eight-room building, with four bedrooms, contains sixty lamps, and each room is equipped with special baseboard outlets for heating appliances, these circuits being wired with especially large copper section. All cooking is done on an electric range in the kitchen, and hot water for the house is supplied from an electrically heated waterback. Energy for the house and hotel equipment is obtained from a nearby water-power plant owned by the hotel estate. Coal at this point costs from $12 to $16 a ton.

Meeting of Polytechnic Society of Colorado Springs.—At the regular meeting of the Polytechnic Society of Colorado Springs, Col., held March 14, Mr. George D. Luther read a paper on the "Ironclad-Exide" electric vehicle battery. Mr. Luther outlined the development of electric vehicle batteries and described various types of batteries that have been used for this service. Besides the members of the Polytechnic Society there were also a number of vehicle users present as well as the employees of the Colorado Springs Light, Heat & Power Company. This company intends to put several electric vehicles into service in Colorado Springs and to push actively the sale of electric vehicles. Professor Griswald, in charge of the Electrical Engineering Department of Colorado College, was the presiding officer.

Baltimore Section, N. E. L. A.—The winter work of the Baltimore Section of the National Electric Light Association has proved of great educational value to the section members. The course of ten lectures being delivered by Dr. John B. Whitehead, professor of applied electricity at the Johns Hopkins University, will be concluded on April 4, when at the last meeting of the educational course the subject will be "Principles of Illumination." At the meeting on Feb. 28 Mr. H. L. Parker, illuminating engineer of the Consolidated Gas, Electric Light & Power Company, lectured on "Interior Illumination." The lecture was illustrated with lantern slides. At the meeting on March 14 Mr. R. H. Tillman, who is in charge of the company's motor-service department, lectured on "Private Plants." On March 28 Mr. William Schmidt, Jr., secretary of the Consolidated Gas, Electric Light & Power Company, lectured on "Corporation Accounting."

Prussian State Railway Electrification.—The adoption of the railway budget containing an item of $10,000,000 for changing the railroad between Magdeburg and Leipzig from steam to electric operation is looked upon as the beginning of the complete electrification of the Prussian State railroads.

Denver Sign Ordinance.—A new sign ordinance before the City Council of Denver, Col, calls for elimination of wood from all classes of signs, and above a certain area all signs must be of mesh construction. The object of the ordinance is to exclude cheap, flat wood signs, both in order to decrease the fire hazard from inflammable structures or buildings and to minimize danger to the public during windstorms.

Pennsylvania-New Haven Connection.—It is said that the Pennsylvania Railroad is preparing to expend $25,000,000 for a link to connect its Long Island tracks with the tracks of the New York, New Haven & Hartford Railroad in order to enable passenger trains from the South and West to run through to New England without being ferried around New York City. Details of the plans for electrification have not as yet been announced.

Public Lands Withdrawn for Water-Power Reserves.—President Taft, acting upon the recommendation of Mr. Fisher, the new Secretary of the Interior, withdrew from settlement 6790 acres of public lands in Utah and Washington on April 1. These lands are reserved for water-power development. The areas in Utah comprise 640 acres along the Provo River and in Washington 3000 acres along the Similkameen River and 3150 acres along Bonaparte Creek.

Tungsten-Coated Silver Lamp Filament.—In a patent issued on March 14 to Mr. Karl Farkas, New York City, a description is given of a process for producing a compound filament for incandescent lamps consisting in heating electrically a fine silver wire in a rarefied atmosphere of about 20 in. composed of about 85 per cent of vapors of a tungsten compound, about 8 per cent of vapors of chloride of silver and 7 per cent of pyrogallol vapors, the result being a metal coating on the fine conductor after reduction in an atmosphere of hydrogen.

Meeting of Los Angeles Section A. I. E. E.—On March 28 the executive committee of the Los Angeles Section of the American Institute of Electrical Engineers held a meeting of the local chapter, preceded by a dinner given at the University Club, at which the following engineers were guests: Profs. Elihu Thomson, C. L. Cory and W. F. Durand, and Messrs. B. J. Arnold, H. A. Foster, G. A. Damon, A. H. Babcock, D. G. Vincent, G. L. Hoxie, K. B. Miller, S. G. McMean, O. H. Ensign, M. M. Corbin, G. H. Hill, R. J. Cash, F. F. Scattergood, T. B. Comstock, G. G. Watson and F. H. Anderson.

Conservation Conference of Engineers.—The National Electric Light Association has issued invitations to about 12,000 members of engineering societies to attend its conference on the conservation of water-powers, which will be held in the Engineering Societies Building, New York, on April 8, at 2:30 p. m. Among other papers and addresses one will be presented on "The Hydroelectric Business from the Investor's Standpoint," and the speakers will include Messrs. John Bogart, H. M. Byllesby, H. L. Doherty, R. D. Mershon, S. Z. Mitchell, J. R. McKee, D. B. Rushmore, L. B. Stillwell and J. G. White, who with others will consider the subject from different angles of approach. The meeting will be open to the public.

Entertainment on Electrical Jobbers' Train.—For the entertainment of the members of the Electrical Supply Jobbers on the special train leaving Chicago for Del Monte, Cal., on April 18, special song-books containing the choruses of 100 popular songs have been prepared. A piano will be provided in the observation car and abundant opportunity will be afforded for using the books. Card tournaments have been arranged and on one night an amateur vaudeville show will be given in the observation car. Other entertainment features have been planned, but they will be "sprung as surprises" upon those making the trip. Mr. H. H. Cudmore, president of the Brilliant Electric Company, is chairman of the entertainment committee.

Compulsory Delivery of Telegraph Message.—On April 3 the Supreme Court at Washington upheld as constitutional the statute of the State of Virginia imposing a penalty upon telegraph companies for failure to transmit promptly messages filed with them. The case came to the Supreme Court on a writ of error to the Supreme Court of Virginia, which found the Western Union Telegraph Company guilty and assessed a fine of $200 for failure to forward promptly a message filed with it at Richmond, Va., by a commission firm, Crovo & Crenshaw, for transmission to a firm in Brooklyn. The opinion, which was written by Justice Lurton, was brief and held that the fact that the transaction was interstate did not deprive the State of Virginia, in the absence of a federal statute, from legislating regarding it.

Chicago Railway Tunnel.—The sinking of the 278-ft. twin tubes for the new La Salle Street street-railway tunnel under the Chicago River was successfully accomplished on Sunday, April 2. The tubes were built at a dry dock on the North Branch of the river and floated to position. They are 24 ft. in diameter, except as the circle of each is modified by a central web constituting a chord of each circle. The width of the two tubes is 41 ft. over all. The outer shell is of steel lined with from 20 in. to 40 in. of reinforced concrete. The work of sinking was done on Sunday when the reverse flow of water in the river, due to the Drainage Canal hydroelectric plant, may be minimized. Steam tugs and electric hoisting engines were used to adjust the tubes in the final position, and water was introduced to sink them to temporary piling. As placed in position the tubes weighed about 8000 lb. Each will contain a street-railway track when completed.

Public Utility Commission for Pennsylvania.—A bill embodying the ideas of Governor Tener covering the establishment of a public utilities commission to supersede the present Railroad Commission has been presented to the State Legislature of Pennsylvania. The Governor, in his pre-election speeches, made some very definite promises as to what he hoped to do in regard to a bill of this kind, and it is said he will exert his utmost efforts to have passed the bill embodying these promises. It is the Governor's idea that a commission with such powers, and properly conducted, would create a better feeling between the people and the corporations and compel the latter to render the satisfactory service for which their franchises were granted. It would protect the companies from unfair attacks and at the same time preserve the rights of the public. It is understood also that a provision will be included in the bill looking to the prevention of over-capitalization of companies. Governor Tener is said to be taking a great deal of personal interest in this bill and has had extended conferences with Attorney-General John C. Bell in an endeavor to draw up the bill so that it may successfully meet any legal or constitutional objections offered to its passage. The bill will establish a commission with power to regulate twenty-nine classes of public service and also corporations or persons engaged in quasi-public business as well as holding companies. The present State Railroad Commission is abolished. The bill is said to go far beyond the law providing for railroad or public-service commissions in other states. The commission is to be composed of five members, who shall serve five-year terms, at an annual salary of $8,000 each.

Fire in Bakersfield Electric Plant.—The breaking down of a transformer in the steam plant of the San Joaquin Light & Power Company north of Bakersfield, Cal., on March 22 is said to have caused the burning out of a 750-kw generator and started a fire that threatened the buildings. In some way, according to a newspaper account, the insulation in a transformer gave way, short-circuiting it and allowing current at 17,000 volts to pass to the generator, which was burned out, setting fire to the building. The loss is said to be $25,000.

Two Hundred and Fifty Thousand Electric Flatirons Sold Last Year.—It is estimated that no less than 250,000 electric flatirons were sold in the United States and Canada last year. There are more than 10,000,000 homes within central-station territory, of which fewer than 2,000,000 have electric service: consequently the estimated sales last year approximate one iron to every eight homes. Although the electric iron was on the market almost fifteen years ago, its general use dates back only a few years. Other electric appliances have a similar history of long neglect followed by rapid introduction.

Telephone Rates in Spain.—Rates for long-distance telephone service in Spain, for conversations of three minutes or fraction thereof, are 9 cents for thirty miles, 22 cents for 125 miles, 40 cents for 250 miles and 75 cents for 500 miles. In connection with the above service a new system has also been inaugurated for the transmission of telephone messages. A fifteen-word message destined to any point without the Province of Malaga may be sent for 19 cents; to any point within the province for 9 cents. These messages are received on blanks similar to those now in use for the telegraph service.

Litigation Relating to Fuel-Oil Supply.—The Los Angeles Gas & Electric Corporation has brought suit against the Amalgamated Oil Company seeking to recover $44,500 from the defendant for its alleged failure to deliver fuel oil. A breach of contract is asserted, and the amount asked represents the difference between oil at 45 cents a barrel, said to be the contract price, and the price which the company is now paying for its oil, which is much larger. It is asserted that the oil company entered into a contract to deliver fuel oil for five years at 45 cents a barrel, but that deliveries were made for two years only and then stopped. The contract expired on Jan. 1, 1911.

Wages of Arc-Lamp Maintainers in Chicago.—A threatened strike on the part of the maintainers of arc lamps used in the municipal street-lighting system of Chicago was averted recently by a compromise in relation to wages. The arc-lamp repairers, who were getting $100 a month, asked for $125 and accepted $110. Of the arc-lamp trimmers nineteen were getting $87 a month and eighty-six were paid $83.33 a month. They all asked for an increase to $100 a month, but agreed to accept $91.67, on which terms settlement was effected. By the old agreement with the arc-lamp trimmers, each man cared for 270 inclosed-arc 100-hour lamps. Under the terms of the new agreement each man will care for 300 lamps, so that the increase in operating expenses will not be so great as the higher rate of wages would indicate. The number of arc lamps in the city street-lighting service is over 12,000 and will be increased to over 22,000 within the next three years by an arrangement with the Sanitary District, which has a contract to take over the street lighting of the city.

Electrical Water Works Pumping in Chicago.—A contract for supplying and erecting the two electrically driven centrifugal pumps to be installed in the West Side pumping station of the Chicago water-works system has been awarded to the Platt Iron Works Company, of Dayton, Ohio, for $53,949. The plan of using electrical energy supplied from the hydro-electric plant of the Chicago Drainage Canal to operate pumping stations in Chicago has been alluded to previously in these columns. Each unit is a horizontal-shaft single-stage pump direct-connected to an alternating motor and capable of delivering 25,000,000 gal. daily under a total head of 115 ft. The contract includes starting apparatus, switchboard, instruments, oil switches, exciters and transformers to reduce the line voltage of 12,000 volts to 440 volts, which is the working potential. Synchronous three-phase, 60-cycle motors of 1000 hp or 8000 kva rating are specified. There will be seven 275-kva water-cooled, oil-insulated transformers, including two banks of three each and one spare transformer not connected. Each motor is provided with an exciter. It is expected that the installation will be ready for service about Sept. 1 of this year.

Emergency Use of the Telephone.—Mr. George K. Gann, of Lincoln, Neb., told an interesting story at the recent Chicago convention of the National Independent Telephone Association to show that in cases of emergency it may be necessary to disregard strict operating rules as a duty to humanity. A woman called up the Lincoln exchange one day in great excitement, and after some difficulty it was found that she was the wife of a traveling man who had left home a day or two before on one of his trips. The wife had just discovered that a bottle of laudanum was missing from the medicine closet, and as her husband was taking cough medicine from a bottle of similar shape, which had been left behind, she was greatly alarmed, realizing that her husband had taken the poison with him by mistake. She rushed to the telephone at once to call up her husband in some way and tell him of his mistake, but she was unable to tell the operator where her husband might be located; she did not even know what state he might be in. The telephone company called up the employer and obtained a list of about twenty towns in one of which it might be possible to locate the man wanted. These places were called up in succession, and after three or four attempts the traveling man was located. In a few minutes a happy though excited woman was talking to a surprised husband. After the latter had succeeded in convincing the anxious wife that he was really alive he told her that he had noticed his mistake shortly after he left home.

Electric Light from Salt and Water.—According to an Arkansas newspaper an inventor at Mansfield in that State has discovered a method of producing electricity for electric lighting from salt and water. The newspaper states that the inventor is a stranger who came to the town about a year ago and has shrouded himself in mystery, living in a house on a neighboring mountain and rarely being visible. The newspaper account proceeds as follows: "Then one day Brice came down to the village post office, where he mailed a number of letters. A week or so later mail began arriving at the post office for him in large quantities. This fact soon became known, and the entire village wagged with gossip as to Brice, the strange lights in his home and the mystery in which he kept himself clothed. Finally aristocratic-looking men began arriving in Mansfield quite frequently and they journed at once to Brice's home. At night the villagers were amazed to see a constant switching on and off of the lights in the Brice home on the mountains. The electricity made by Brice's system makes a better light than the present electricity. It can be made 75 per cent cheaper than the present kind. The most remarkable part of it all is that the electricity is perfectly harmless, except that a charged wire will burn. However, it produces no shock and can be handled with perfect ease and without danger, except that to come in contact with it will have the same result as placing one's hand on a red-hot iron. Brice refuses to reveal his secret, declaring that already a plan is on foot to rob him of his invention. However, it is known that an effort is now being made to place his invention on the market and that a gigantic company is in process of organization."

STEAM TURBINE GENERATING STATION AT STILLWATER, MINN.

THE new steam turbine station of the Consumers' Power Company at Stillwater, Minn., will provide relay service for the water-power plants of the company at Riverdale and Somerset, furnishing energy for the adjoining towns of Stillwater, White Bear, Riverdale and Somerset.

The Stillwater steam plant has been designed for an ultimate capacity of 2250 kw in turbine-driven units, the first 750-kw unit of which has been installed. This station has also been planned as a switching point for the circuits from the two 500-kw hydroelectric plants on the Apple River at Somerset and Riverdale, twelve and ten miles distant, respectively, from Stillwater. An interesting operation feature of the station is the motor-driven pump intake for supplying circulating water to the condensers.

The plant building is a brick structure 73 ft. x 92 ft., the boiler-room occupying 50 ft. and the generator room 42 ft. of the major dimension. The present boiler equipment comprises two 320-hp Stirling boilers with twin flues entering a 6-ft. steel stack 135 ft. high. This steam-generating installation will be duplicated when the remainder of the turbine apparatus is installed.

From the 8-in. main header in the boiler-room a 5-in. steam line is brought overhead to the 750-kw horizontal Curtis turbine driving its 2300-volt, 60-cycle General Electric alternator at 1800 r.p.m. This turbine exhausts through a 28-in. line into a Wheeler surface-type condenser mounted on the basement level directly beneath the turbine setting. This exhaust line is also provided with a 12-in. relief pipe opening to the atmosphere. Turbine, generator, condenser and auxiliary apparatus have been grouped as a single unit, the same design being extended to the two future 750-kw turbine units to be installed in the station.

Cooling water for the condenser is taken from the St. Croix River, 150 ft. from the plant, through a special intake designed to accommodate the changes in level to which the river is subject. The arrangement of this pump-house is shown in the accompanying sectional elevation. The river intake crib, erected 50 ft. off shore from the pump-house on the bank, is built up of 10-in. piles tied together by 6-in. x 10-in. timbers, which form the frames for two tiers of 9-ft. x 3-ft. racks made up of 2-in. x 0.375-in. bars at 0.75-in. intervals. From the bottom of this 18-ft. crib a 24-in. pipe extends shoreward to the base of the 15-in. draft line of the 100-hp induction motor-driven center-discharge centrifugal pump at the shore level 19 ft. above. This pump discharges into an 18-in. pipe line to the condensers in the generator room 150 ft. distant. Provision has also been made for a second similar pumping unit in the pump-house, which is 12 ft. x 13 ft. in plan. At this point the St. Croix River undergoes changes of level from an extreme stage of 14.6 ft. down to 0.7 ft., the intake being designed to accommodate itself to this range. The present season has marked the lowest stage reached by the river since 1868, but no difficulty has been encountered in supplying ade-

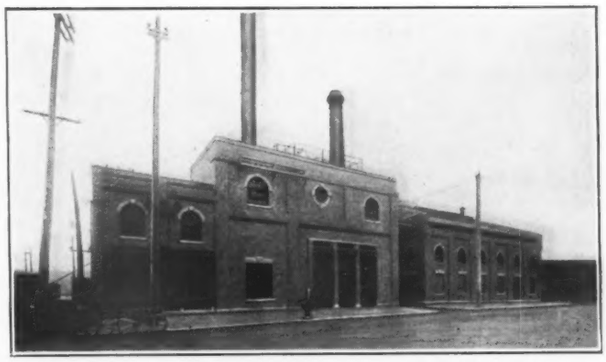


Fig. 2—Reconstructed Power Plant and Switching Station of Consumers' Power Company.

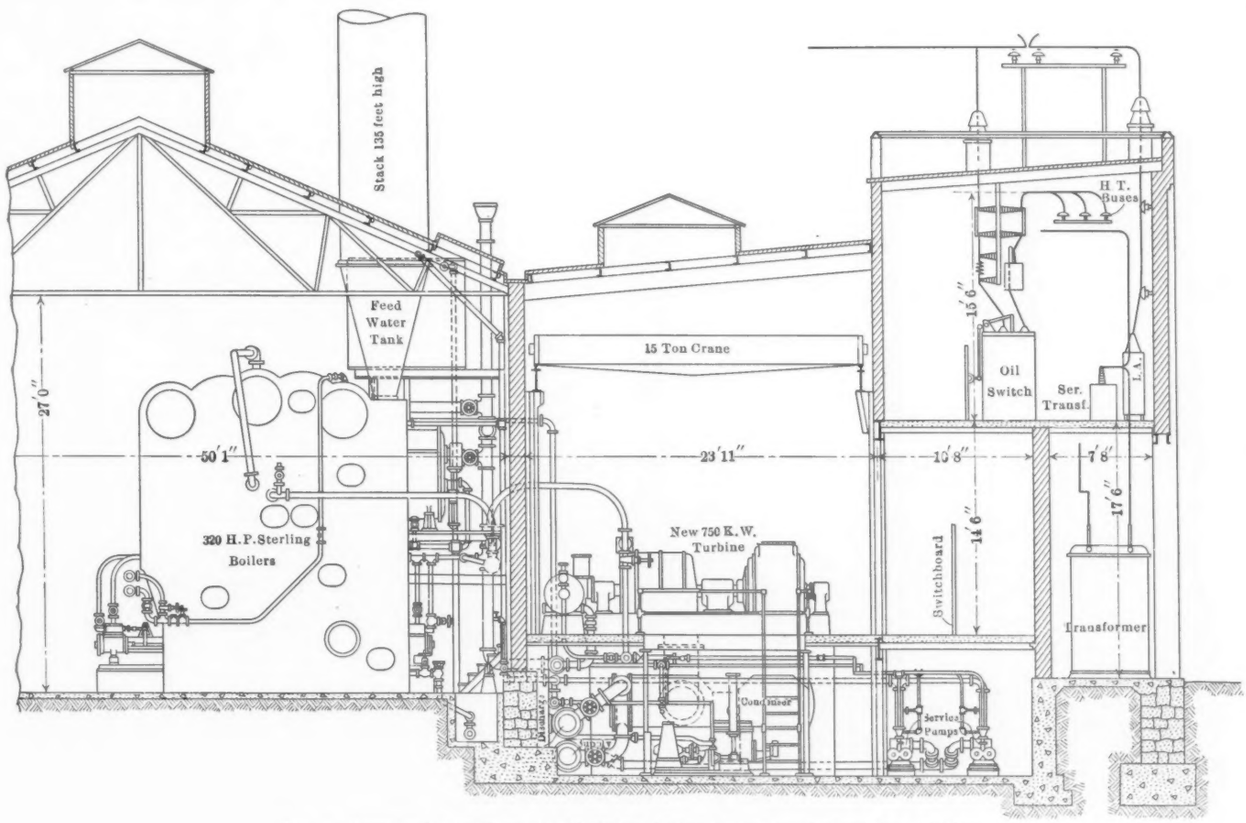


Fig. 1—Sectional Elevation of Stillwater (Minn.) Turbine-Generating Station.

quate quantities of condenser water to the turbine. The pump space is provided with a hand-tackle for installing and changing machines. The house is electrically lighted and the pump motor is controlled from a starting compensator panel in the turbine-room. An 18-in. pipe similar to the intake line returns the condenser water to the river. The service-pump supply is taken from the incoming inlet water and the boiler-feed supply from the discharge water. An engine-driven Rotrex vacuum pump is employed to remove the air and water of condensation. The condensate is returned to the feed-water tank over the boilers by a small centrifugal pump chain-driven from the shaft of the Rotrex pump.

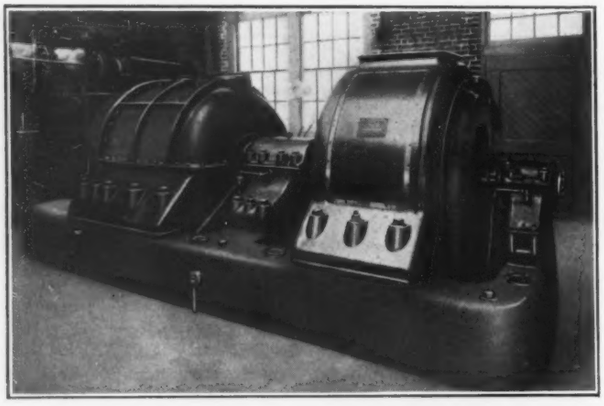


Fig. 3—750-kw Horizontal Turbine in Stillwater Plant of Consumers' Power Company.

Steam for the 35-kw General Electric turbine-driven exciter generators, of which two are installed, is supplied from the 4-in. auxiliary header under the generator-room floor.

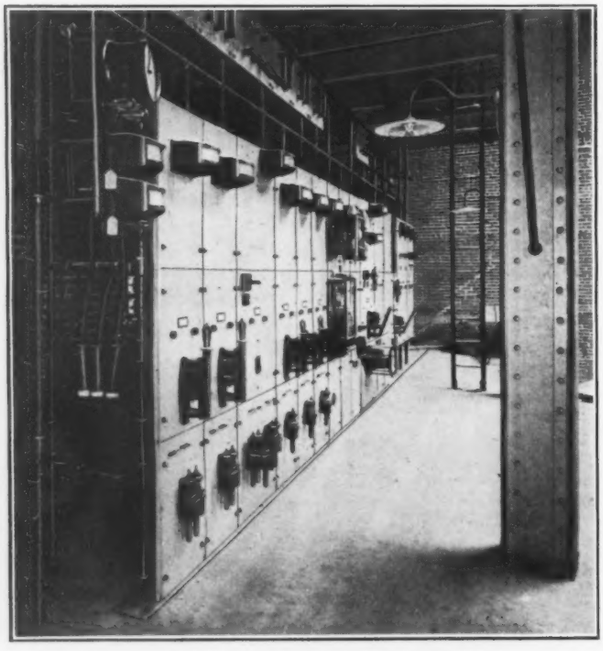


Fig. 4—Switchboard.

The switchboard containing the generator panels and transformer and line-switch control is mounted in the turbine-room in front of the transformer compartments. These six individual concrete cells for the 250-kw, 2300-15,000-volt, self-cooling, oil-insulated step-up transformers are of concrete, with 7-ft. x 8-ft. interiors. The cells communicate with the front of the station, being closed by Kinnear roller steel doors in the front outside wall. Above these doors special ventilating transoms are arranged to provide air circulation to aid in cooling the transformers, the shutters being held open by weights, cords and fusible links, so that in case of accident or excessive temperature rise the cell is quickly and automatically closed to the outside air.

From the high-tension terminals of the transformers the 15,000-volt lines are led up through the ceiling into the high-tension switching gallery, through the series transformers, across under the high-tension bus structure and down to the oil switches. Thence the outgoing energy traverses hook-type disconnect switches to the high-tension buses. The outgoing lines from the 15,000-volt buses are brought down through disconnect switches and series transformers to the line switches, from the line terminals of which they are taken, through the choke coils and disconnect blades, directly up to the vertical roof-entry insulators. Here they tap at a 90-deg. angle onto the line wires which are carried through to the lightning-arrester spark gaps and down through similar porcelain-roof insulators to the aluminum-cell lightning arresters on the high-tension gallery floor. The incoming line wires are similarly equipped, except that the oil switches between buses and line have been omitted. All of the transmission lines entering the

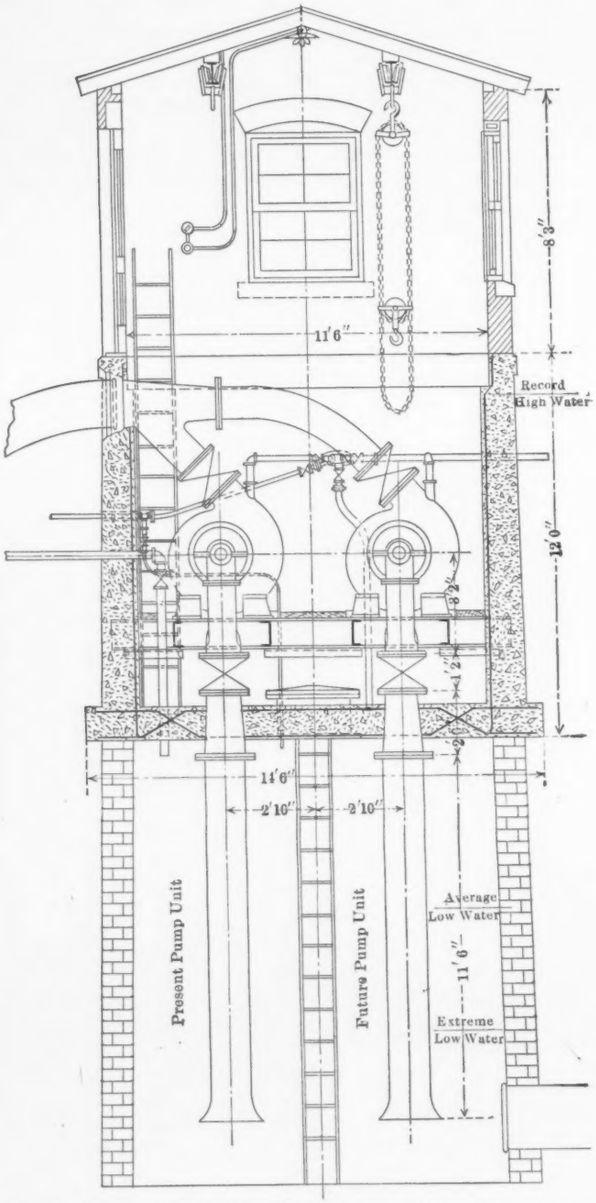


Fig. 5—Sectional Elevation of Condenser Water Pump-House.

station are of No. 2/0 copper cross-section. Through lever extensions from the spark gaps on the roof of the high-tension structure the aluminum-cell arresters can be discharged from the gallery floor. The concrete-floor area surrounding the aluminum cells themselves is waterproofed with special oil-resisting material and is inclosed by low coffers formed of the vertical webs of angle-irons anchored to the floor, preventing the spreading of any oil or electrolyte solution which may be thrown onto the floor from the arresters.

Among the interesting motor loads served by the Stillwater plant is the Minnesota State penitentiary near the town, where motor-drive is used in factory operations. Electricity for motors is also used by the contractors engaged in building the new State prison. Two shoe factories and a flour mill also have electric drive. The total connected load in motors in Stillwater is 764 hp. The population of the town is 10,000 and the company has 1000 electrical consumers on its lines. The rate for lighting service is 15 cents per kw-hour for the first six units and 10 cents per kw-hour for all additional energy used up to 100 kw-hours per month.

The Stillwater steam turbine station was designed and erected under the supervision of the engineering department of H. M. Byllesby & Company, which manages the Consumers' Power Company. Mr. Herbert Markle is local manager at Stillwater and Mr. J. W. G. Johnson is superintendent.

MODERN ALTERNATING-CURRENT COAL DOCKS AT DULUTH, MINN.

On their return trips to Duluth the great fleet of ore and grain carrying vessels which ply to the ports of Lakes Michigan, Huron and Erie carry hard and soft coal from Eastern fields, destined for the consumers of the Northwest. In a single year as much as 7,000,000 tons of coal is handled by the twenty-one Duluth coal docks, which have an aggregate storage capacity for nearly 6,000,000 tons. The work of transferring this tremendous quantity of fuel from the lake vessels to the storage bays and then again to railroad cars as it is needed for consumption has become one of the important services of the hydroelectric energy developed by the Great Northern Power Company's water-power plant on the St. Louis River at Thompson's Falls, eighteen miles west of the city.

Of the twenty-one coal-storage docks at Duluth eleven of

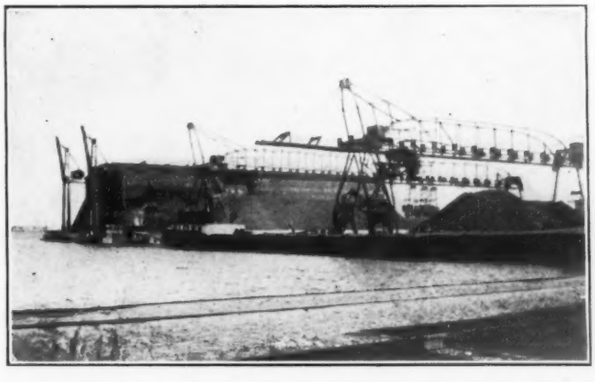


Fig. 1—Two-Bay Alternating-Current-Operated Coal Docks at Duluth.

the principal and newest ones are operated by electricity, all of these but two employing alternating-current motors for all operations. The 25-cycle energy for operating these great docks is transmitted eighteen miles at 30,000 volts from the 39,000-hp Thompson Falls plant, developing a 375-ft. head in the St. Louis River, to the terminal substation at Duluth, where it is stepped down to 13,200 volts for local distribution. A large part of this transmitted energy is utilized for the electric lighting and street-railway services in the adjoining cities of Duluth and Superior, Wis., where the Great Northern Power Company wholesales energy to the Duluth Edison Company, the Superior Water, Gas & Light Company and the local street-railway companies, reserving for itself in both cities the business of supplying blocks of power to customers whose demands exceed 50 hp. Other interesting uses of this hydroelectric energy are the 1000-hp motor-driven Duluth water-

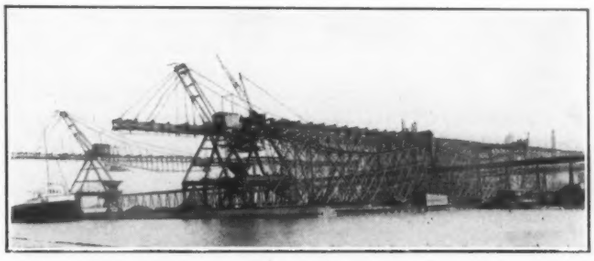


Fig. 2—New Three-Bridge Alternating-Current-Operated Coal Dock at Duluth.

works pumping station, twelve miles east of the city, and the 7500-kw electric furnace load of the Carbolite Company, manufacturer of calcium carbide, both of which services are supplied directly from the system of 13,200-volt lines radiating from the Great Northern company's Duluth substation.

The most modern of the coal docks at Duluth are of the so-called "man-trolley" type, in which the operator's cab is mounted on the hoist carriage, so that the operator always has a clear view of the movements of the bucket suspended beneath him. Four of these great man-trolley docks driven by alternating-current motors are now in operation, and two other large ones, with storage capacities for handling 600,000 tons and 1,200,000 tons of coal respectively, will be completed next year. The coal-storage areas of the docks are usually divided into two or three bays, each 250 ft. wide and sometimes 2000 ft. in length, parallel to the water's edge. Each bay is spanned by several steel bridges having folding cantilever arms extending over the water's edge and forming part of the trolley way which extends back 500 ft. to 750 ft., to the extreme rear of the dock. These bridges are arranged for side travel along their parallel rails at a maximum speed of 50 ft. per minute, being driven by four 75-hp motors through shafts and gearing. The side travel is employed for moving the bridge from one hatchway to the next as the process of unloading goes on. Travel-

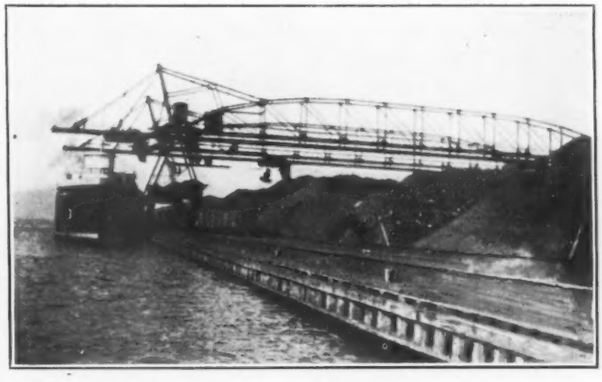


Fig. 3—Single-Bridge Coal Docks Unloading from Vessel at Duluth.

ing on the overhead bridges are the hoist carriages supporting the buckets, which are thus enabled to run out onto the cantilevers overhanging the vessel hatchways, returning to dump into the hoppers feeding to the cars along the docks or to discharge onto the storage piles extending 500 ft. or more back from the water line.

In the Heyl & Paterson type of "man-trolley" dock, of which three docks are now in operation at Duluth, the 25-cycle energy

for the various motors is distributed directly by 13,000-volt catenary trolleys to the carriages, on which are mounted the transformers stepping-down to 440 volts for the motors. A 150-hp motor is employed to close the bucket, which weighs eight tons and which holds five tons of coal. For hoisting this bucket the 150-hp bucket-closing motor is arranged to aid a special 150-hp hoist motor, the combined 300 hp in motors raising the bucket at a vertical speed of 300 ft. per minute. For "racking" or trolleying the 50-ton carriage back along the bridge two 75-hp motors are employed, driving the carriage with its loaded bucket at a speed of 1000 ft. per minute. These bridges are manipulated by Westinghouse pneumatic-control apparatus with direct-current auxiliary circuits. In addition to the air brakes dynamic braking within the motors themselves is accomplished by throwing 125-volt direct current through the motor stators, causing the induced currents generated in the revolving rotors to bring them to rest.

The accompanying chart shows the power demand during a typical cycle of operation of one of the crane bridges just described. The first peak is due to closing the bucket through the coal in the vessel's hull; the second and highest one represents the starting power taken by the hoist motors. At the third peak "racking" or carriage travel begins and continues for twenty-two seconds until the bucket is emptied. The return trip then begins and the bucket is lowered again into the hold. The approximate duration of these peaks is indicated on the diagram, which shows a cycle unloading coal from the boat to the rear bay of the dock. These bridges were guaranteed to deliver 250 tons per hour from the hold to the car hoppers, but the actual delivery of ninety-eight trips has been 445 tons during an hour. A ten-hour record held by the two bridges is 5000 tons of coal handled.

When freight cars are available the coal is delivered directly into the car hoppers from the boats, but during most of the open season for navigation, when there is little demand for fuel, the coal has to be deposited in the storage bays for reshipment during the winter as needed. While the rate of unloading during "cutting down" into the full hatchways is very high, some time is lost after the bottom of the hold is reached and trimmers have to shovel the coal by hand into piles for the bucket to handle. Eleven-thousand-ton vessels have been unloaded in eighteen hours by three bridges at Duluth.

The newest coal dock erected at Duluth is one built by the Brown Hoist Company, arranged with three bridges moving over two 250-ft. bays, and a fourth bridge spanning the third bay, which is arranged to be coupled and operated with any of the other tandem bridges. In this bridge the hoist travel is 200 ft.

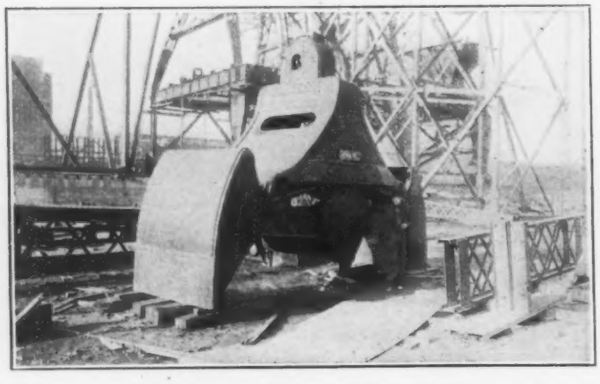


Fig. 4—Bucket of New Alternating-Current Coal Dock at Duluth.

per minute, the bucket being lifted by a 225-hp motor which also performs the closing operation. The trolley is driven by two 112-hp motors at a speed of 1200 ft. per minute along the bridge. The lower hoisting rate is designed to relieve the peak noted in the characteristic cycle diagram, the higher trolley speed throughout the longer period of "racking" more than compensating for any loss of time in hoisting. In this type the 13,200-volt, 25-cycle energy is reduced through transformers installed in a substation on the dock to 440 volts, at which it is distributed to the trolleys, relieving the carriage of the weight of transforming apparatus. This new equipment has been only recently installed and has not yet been fully tested in operation, but is guaranteed to deliver 450 tons per hour to the first hopper or 350 tons per hour to the first bay. Besides the

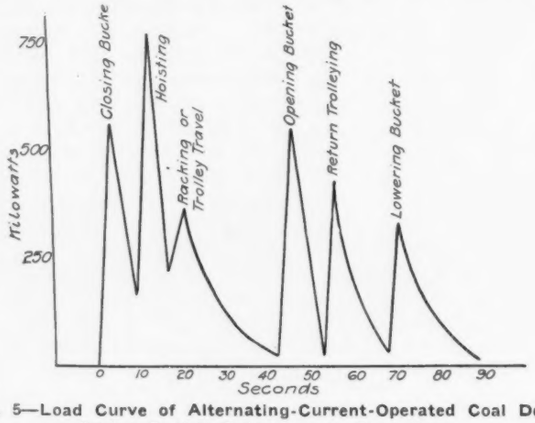


Fig. 5—Load Curve of Alternating-Current-Operated Coal Dock Bridge Bucket Delivering to Rear Bay.

friction foot brakes installed the motors are arranged for dynamic braking, operating as asynchronous generators.

Each coal-dock customer's lines are equipped with a totalizing watt-hour meter and a curve-drawing wattmeter, from the readings of which the bill is computed. The rate is based on a demand and an energy factor. The former charge is $1 per month for each kilowatt of demand of the "minimum rating" of customer's load. To this is added 1.1 cents per kw-hour up to a consumption of seventy times the minimum rating and 0.5 cent per kw-hour for all additional use. The "minimum rating" of the customer's load referred to is taken to be his assumed maximum demand during a five-minute peak, or 40 per cent of his maximum instantaneous peak, 50 per cent of his one-minute peak, or 33.3 per cent of his three-minute peak, as determined by the graphic-wattmeter record.

The results adduced from a careful study made by Mr. J. B. Crane, commercial engineer of the Great Northern Power Company, of the energy consumption of the three man-trolley docks before described show that 889 watt-hours are required for handling a ton of coal from the hold to the average storage bay. Carrying an average of 4.43 tons to the trip throughout the entire process of unloading and trimming the empty hold, this represents a consumption of 4.42 kw-hours per trip. The highest instantaneous peak of this four-bridge dock during a month has been 1967 kw, indicating a virtual load-factor of 8.5 per cent. Taking the computed "minimum demand" to be the virtual peak, the load-factor for the same month becomes 21 per cent.

An older type of coal-conveying apparatus, less modern than the "man-trolley" docks, is the cable-operated bucket dock, of which several are in use at Duluth. In these docks the trolley carrying the bucket is drawn along the bridge by a cable, the winch motors being controlled from one or two stationary operators' cabs, one at the front of the bridge, commanding a view of the bucket in the vessel's hold, and the other at the rear, in sight of the coal piles. One interesting dock of this type at Duluth has screening towers for grading the coal received. Its 250,000-ton storage area is served by three traversing-bridge tramways to which the 440-volt, 25-cycle, three-phase energy is conducted from special contact posts on the dock engaging with trolley conductors carried by the bridges themselves. The bridges are 506 ft. long, serving two bays, the principal span being 300 ft. with cantilever-boom extensions overhanging the front and rear of the dock. The bucket is hoisted by a 225-hp motor and the trolley racking motion and side travel are imparted by two 75-hp motors. The racking speed along the bridge is 300 ft. per minute and the hoist speed

is 250 ft. per minute. In practical unloading tests this dock has handled 85,266 tons in 239 hours, making 34,933 trips. Round trips from the vessel to the storage bay, 270 ft. distant, were made in forty-five seconds. Three bridges made 822 trips in 693 minutes, unloading 10,500 tons of coal in twenty-six hours. During a month this three-bridge dock consumed 51,840 kw-hours, attaining an instantaneous peak of demand of 1400 kw.

Other large electric coal docks will be installed at Duluth coincident with the opening of the extensive new plant of the Minnesota Steel Company, a subsidiary of the United States Steel Corporation, which is now under construction on the shore of St. Louis Bay, west of the city. This plant is understood to be built especially for the purpose of reducing and converting the lower grades of ore which it is not profitable to haul to the Eastern blast furnaces. Instead, the coal from the Eastern fields will be brought to Duluth and there utilized for reducing the ore of low-percentage iron.

Besides furnishing energy for the motors of the coal docks at Duluth, the 25-cycle hydroelectric energy is used to light the bridges and bays for night work. For this purpose several hundred 25-cycle flaming-arc lamps are successfully used about the docks, giving no trouble or perceptible annoyance due to the frequency of flicker.

MODEL SMALL MUNICIPAL PLANT AT PRINCETON, ILL.

ALTHOUGH the electric light plant at Princeton, Ill., is run as a municipal venture, it has benefited from the practice of keeping a practical superintendent in charge, without respect to the varying political fortunes of the heads of the city government, so that the history of the electric light service has been a successful one. The plant itself is one of the model installations of its section of north-central Illinois, having been recently equipped with new direct-connected engine-driven generating units. The electrical station occupies part of the building with the city water works, with which it shares the steam-generating equipment and the operators' attention.

Three 150-hp Kewanee boilers are installed for supplying

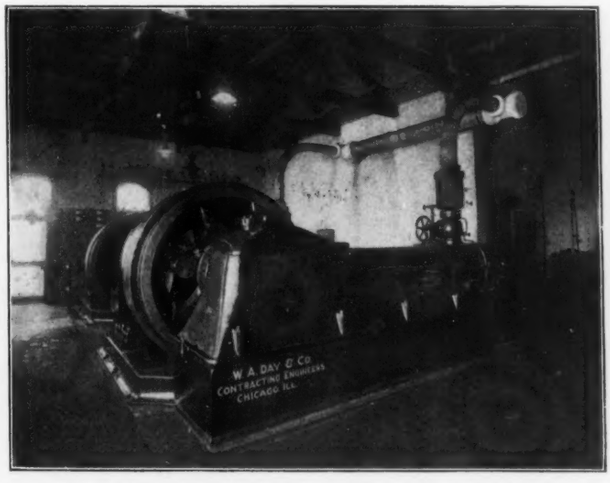


Fig. 1—Interior of Engine-Room of Princeton Municipal Plant.

steam to the flywheel pumping engines in the water-works section and to the total of 320 hp of engines driving the electrical apparatus. This electrical generating equipment has been divided into two units of unequal ratings in order to carry the station electrical demand more efficiently. The larger unit comprises a 15-in. x 21-in. Erie City engine driving a 150-kw, 2300-volt, 60-cycle, three-phase Fort Wayne alternator at 200 r.p.m., while the smaller set is made up of a similar 13-in. x 18-in. engine driving an 85-kw alternator at 225 r.p.m. Each alternator unit is provided with a belted exciter. The engines are of the horizontal, protected type and are controlled by inertia-type governors. Solid concrete foundations for the machines are carried through the cement floor to a good bearing base beneath the plant sub-basement, through which the conductor cables are carried in conduit to the switchboard at one side of the engine-room. This switchboard comprises eight

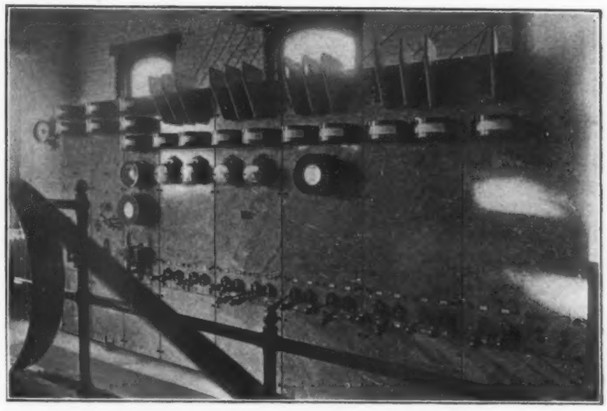


Fig. 2—Switchboard of Princeton Lighting Plant.

marble panels; two from which the generators are controlled, one totalizing panel equipped with a watt-hour meter by which record is made of the entire output generated by the station, and five line panels through which pass the outgoing commercial and street-lighting lines. All of these panels are provided with phase ammeters for reading the currents in the various wires and an extra totalizing watt-hour meter is provided for summing up the energy used by the town street lighting. A three-phase ground detector is installed on the totalizing panel, and a synchroscope, mounted on a swinging bracket, is arranged at the left of the two generator panels. The 2300-volt switches are of the plug-and-socket type for the commercial-lighting and street-lamp circuits.

Princeton is a peculiarly shaped "dumbbell" town. Years ago, before the coming of the railroad, that end of the present community known as South Princeton was already settled. Then the railroad was built, its line running almost a mile north of the established town center. In the course of events

Fig. 3—Series-Tungsten Illumination of Main Street, Princeton, Ill.

a few houses grouped themselves about the newly built station, a storekeeper or two moved down to the new settlement by the "depot," and soon a second or rival business center was established at the railroad station. Meanwhile the road or street connecting the two centers had been built up with pleasant residences, and in later years the binary town board decided to pave the link of roadway that binds the halves together. Soon the splendid street became the virtual boulevard of the com-

munity, and it was decided that more adequate lighting was necessary. The construction of the new electric light plant about this time made this possible, and 140 40-watt series tungsten lamps were installed, one on each of the trolley poles supporting the conductor wire of the electric car line that connects the two civic centers. These 40-watt series lamps, protected by metal shades, are carried on bracket arms mounted on the trolley poles at intervals of 100 ft. along the curb, and after nightfall present a virtual "wide, white way" when viewed from either end of the street. The appearance of the illuminated street, taken on a snowy winter night, is shown in Fig. 3. The cost of this installation throughout the twenty-five blocks, approximately six lamps to the block, was $1,200, complete for lamps, reflectors, brackets and line. In addition to the 140 lamps on Main Street referred to there are also about 500 other series tungsten and carbon lamps used in the street-lighting circuits of Princeton.

The electric lighting department has 450 metered customers, although a few flat-rate services remain. The total income of the plant during the last year was about $8,000. Of this, $4,400 was expended in operating costs and $2,000 in new construction during the year, including the Main Street lighting and the erection of several transmission lines about the city, leaving the net income on the twelve months' operation $1,600. The rates for electrical energy in Princeton are as follows: 1 kw-hour to 10 kw-hours, 15 cents; 11 kw-hours to 20 kw-hours, 12 cents; 20 kw-hours to 50 kw-hours, 10 cents; 50 kw-hours to 100 kw-hours, 9 cents; over 100 kw-hours, 8 cents.

Mr. W. S. Moore is superintendent of the Princeton municipal plant.

TYPICAL LOCOMOBILE ELECTRIC PLANTS.

By Warren H. Miller.

IN this country there is little idea as to the spread of the locomobile, or superheated steam unit, throughout Europe and her over-sea trade dependencies. This is particularly the case with isolated electric stations, large central generating plants and other places where easy attendance and small coal account are desirable. Of the many thousands of these steam units placed by the Wolf company alone, the largest repeat orders are from the great electric companies, the Siemens-Schuckert Company leading the list with 174 locomobiles and the A. E. G. (German General Electric) showing 140. Friedrich Krupp comes next with sixty-three and the Imperial State Railways with forty-eight repeat orders. Of 9584 locomobiles, with a total rating of 725,000 hp, 1615, aggregating 136,770 hp, are used in electric generation, being exceeded in number (but not in horse-power) only by the 1885 superheated steam units employed in the wood-working industries.

The construction of the locomobile was described by a writer in the *Electrical World*, June 2, 1910. Briefly reviewed, the so-called locomobile is a compact arrangement of boiler and engine in which the heating surface available in the boiler is divided up somewhat more rationally than with the ordinary steam boiler, allowing only a certain part of the heating surface for evaporation and devoting the balance to superheating. While the record consumption is held by a small 138-hp locomobile at 7 lb. of steam per brake hp-hour (Magdeburg Boiler Association test, Jan. 21, 1910) the average consumption ranges from 8.5 lb. to 9.5 lb. of steam per brake hp-hour, or from 1.05 lb. to 1.12 lb. of coal per hp-hour. This average extends over a range from 70 hp up to 800 hp and even as high as 1200 hp in the large Lanz locomobiles, such as were exhibited at the recent Brussels Fair.

This consumption does not depend to any large extent upon the size of the unit; in fact, the record up to last year was held by a 70-hp Wolf locomobile with double superheat, the high-pressure cylinders being located in the smokestack, the steam consumption of this engine being 8 lb. per hp-hour. This is from one-half to one-third the best consumption of our own engines of equal horse-power. The low consumption is attributable to several causes combined, the principal of which are the elimination of cylinder condensation, boiler feed-pump waste and heat losses in the stack and in the piping.

It is difficult to refrain from commenting upon our alleged progressiveness when it is realized that there is not in central-station service in the United States to-day a single locomobile unit, though they have been known for the past ten years in Germany and have become the standard prime mover for central-station plants and all sorts of isolated drives. The Wolf and Lanz companies have built over 20,000 of these units, now in use all over Europe, throughout South America, India, East Africa and even China.

Without again going into the technique of the locomobile, or "superheated steam unit," this article will note at random a few typical installations of the locomobile in different parts of the world in order to remove the idea that seems to prevail among American engineers that this apparatus is experimental. The fact is that if ignorant Chinamen, Malays, bushmen of Africa and South American half-breeds can serve as combined engineer and fireman, as they do on units as large as 350 hp, our own "licensed" engineers should find no trouble in learning to do so.

Fig. 1 shows the generating station of the Central Electric Company, of Concepcion, Chili, a plant of three 205-hp locomobiles driving generators in parallel. The illustration shows the entire plant. The locomobiles are compound condensing, with high-pressure and low-pressure cylinders cast in one piece with the steam dome which jackets the two. There is double superheat—that is, first, the saturated steam at 170 lb. is led from the dome by a pipe running inside the boiler above the water line, comes out through a nipple and enters the first superheater. This is a spiral coil in the smoke box, three spirals deep, and the saturated steam enters it at the outer layer at the stack end, passing inward toward the flue pipes. The boiler gases leave the flue pipes at a temperature

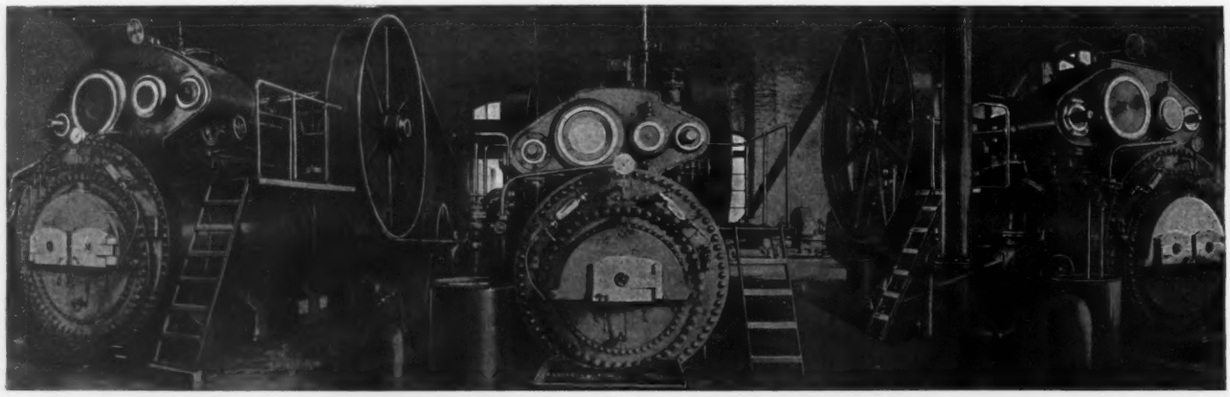


Fig. 1—Generating Plant of Central Electric Company, Concepcion, Chili.

of about 700 deg. and traverse the superheater coils, giving up their heat to them and superheating the steam inside to about 570 deg. The gases leave this superheater at about 400 deg. and traverse a second set of coils, which are in multiple instead of spiral and contain the steam from the high-pressure cylinder on its way to the low. Going back a step—the steam in the first superheater at 570 deg. enters the high-pressure cylinder and expands down to receiver pressure, say 4 lb., and its temperature falls without condensation to about 260 deg. It then enters the low-pressure superheater, where its temperature is raised to about 370 deg.; it then passes to the low-pressure cylinder and expands down to condenser pressure, losing heat down to about 150 deg. It then passes through a feed-water heater which reduces the temperature to nearly 90 deg. as it is released to the condenser. Meanwhile the flue gases in traversing the high-pressure superheater give up heat to it so that they reach the chimney at the temperature of about 340 deg. It will be seen that the Chili engines get about every stray heat unit out of every pound of coal consumed. The coal consumption is only 625 lb. per hour for all three locomobiles, so that two men suffice to feed the furnaces and run the whole plant. The floor area occupied by the plant is 45 ft. x 60 ft. If American engineers were required to put in a similar plant of three 200-hp units for street railway service, bidding against the Germans, they would have to offer about as follows: Three compound high-speed engines consuming about 18 lb. of steam per indicated hp-hour, say, 20 lb. per brake hp-hour; three tubular boilers at 250 lb. ultimate pressure; two duplex steam pumps for boiler feed; one feed-water heater; one economizer. Floor area, for boilers, economizer, etc., 40 ft. x 40 ft.; for engines and generators, 40 ft. x 45 ft. Coal consumption, 1500 lb. per hour. The German plan would be better in first cost, in floor space, and above all in economy, the saving in coal being 900 lb. per hour, or about, roughly, $35 a day less in coal expense. In attendance there would be required at least one engineer and one oiler for the three engines and at least two firemen to the shift, the total cost being $15 a shift, against which the Germans would offer to run the plant on $7 a shift for attendance. It is pertinent to ask, Where should we stand in the eyes of the Chilian engineer buying the plant, and why do we not have some of these up-to-date equipments in our own country?

In Fig. 1 will be noticed the arrangement of the firebox,

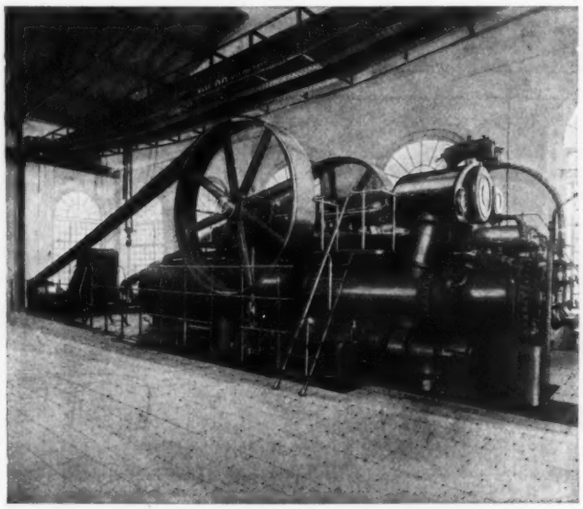


Fig. 2—Central Electric Plant, Weltevreden, Batavia.

whereby the whole end of the box, which is a standard marine corrugated furnace, may easily be taken off by unscrewing the nuts of the stud-bolts in the rear head of the boiler. The forward head has a similar circle of studs, except that they are in the tube-sheet head and project through the boiler head, being secured by nuts outside in the smoke box. Both heads are packed with vulcabeston packing, and by removing the nuts the entire furnace and tubes can be withdrawn for cleaning, which also permits men to go inside the shell and clean out around all gussets, etc. All this is possible because the grate itself is very small compared to the amount of coal an ordinary boiler has to burn to provide steam for its engine. The standard grate for a 250-hp boiler, allowing 30 lb. of water evaporated to be reckoned as a horse-power, is 6 ft. wide

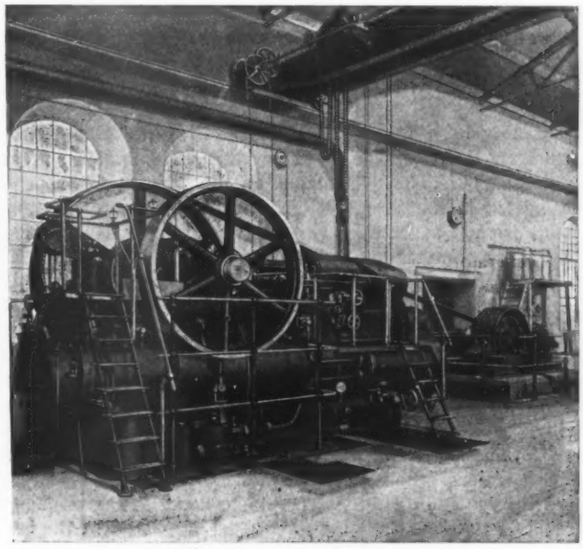


Fig. 3—Generating Plant at New Peterhof Palace, Russia.

by 7.5 ft. back to the bridge wall. In a locomobile of the same size, allowing 10 lb. of water evaporated to the horse-power, it is 3.5 ft. wide by 4.5 ft. to the back of the fire. For the same reason it is possible to install a crude oil-burning system that will not introduce such enormous temperatures on the crown sheet, for a large easy grate can be used and a moderate degree of heat obtained by projection of the burning oil and air upon suitable refractory briquettes. In other installations this same grate matter comes up, and locomobiles are found easily burning tan-bark refuse, straw, shavings and low grades of brown coals, because there is plenty of room to get a large grate surface inside the boiler for the low-grade fuels without having to make an external furnace for the grate, as must be done with an ordinary boiler where the shell itself is not large enough to give a sufficiently wide grate to handle low-grade fuels directly under the boiler.

Fig. 2 shows a large central electric installation at Weltevreden in Batavia. The plant contains a compound condensing 440-hp locomobile driving a generator from each of its two flywheels and is arranged to burn crude petroleum.

Fig. 3 shows another type of locomobile, which differs from both of the above in being tandem-compound instead of cross-compound and in having both the high-pressure and low-pressure cylinders located in the smokestack, being jacketed by the waste heat gases instead of by the saturated steam in the dome. By a suitable channeling in the cylinder jacket casting the heat jacketing for the high-pressure cylinder is taken directly from the flue pipes, while the low-pressure cylinder is heated by the gases after they have passed through the superheater coils of the high-pressure cylinder. The stack gases themselves are of too low a temperature to be of much use to jacket either cylinder. This type of locomobile has shown remarkable economies and has held, up to the present, all the records, such as 8 lb. of steam per brake hp-hour for the 80-hp and 7 lb. (the world's record) for the 135-hp. The specimen shown is one of the 135-hp type and runs the Czar's electric generating equipment for his famous new Peterhof palace. Concerning the 80-hp size, Messrs. Caavedra, Benard & Company, importers, of Valparaiso, Chili, write: "We installed and operate this machine without the assistance of any erecting engineer from the Wolf representatives and find that it works

very simply and with a low consumption of oil. A native Chilian runs the entire installation and gets 8.5 per cent better results out of the coal than the Wolf guarantee. The locomobile was ready for service before the condensing outfit could be erected, so we started it and found that we were getting 95 brake horse-power without condensation. This rose to 120 hp upon starting the condenser. The coal consumption, using Chilian brown coal of 6000 calories, runs 0.8 kg per brake hp-power. We consider these results rather remarkable for a native, untrained fireman, oiler and engineer combined to get from such a plant." This firm has since ordered twenty-seven locomobiles, aggregating 2215 hp.

Fig. 4 suggests a point in which the locomobiles ranging from 200 hp to 335 hp have shown themselves especially desirable —that is, as a standby or steam reserve for water and gas-engine plants. The two engines in the illustration happen to be located in the saltpeter mines in Chili and are of 200 hp each, driving in parallel two three-phase alternating-current generators for running induction motors in the mines. The locomobile, occupying as it does such little floor space and having a very low coal consumption when under banked fires, makes a most excellent standby for any hydroelectric plant, as it can be placed in the same room with the turbines and requires no extra boiler house or other complications attendant upon using an ordinary steam plant. In Wangen, in Switzerland, a 335-hp locomobile generating unit runs in parallel with two turbines, all being under the greatest fluctuation of load. The operators speak in the highest terms of the quick and positive regulation and the general excellence of the valve gear. It may be mentioned in passing that the valve gear of the Wolf engines differs but little from the ordinary piston valve of a saturated steam engine, except that the sleeve is of cast iron instead of brass and the valve itself is lightly proportioned with due attention to heat expansion. The Lanz gear is quite different, being of the well-known lift valve or ventil gear type, known throughout Europe as the "Lentz system" of valve gears. It is used on large slow-speed engines running on superheated steam by all the large engine builders, such as Bollinck in Belgium, Tosi in Italy, Krupp in Germany and Dujardin in France.

A typical Lanz installation is that in Lourenço Marques, on Delagoa Bay, Portuguese Southeast Africa. This is a 225-hp compound condensing unit, with no valve-rod packing and no piston-rod packing beyond a cast-iron automatic contrivance wherein the exhaust of each stroke takes away all the steam that tries to escape into the stuffing box around the piston rod. This locomobile runs as "isolated" an electric light station as the writer has yet heard of, as the engineer-fireman is the only white man on the plantation that does anything resembling work.

Fig. 5 shows the electric generating station of the Brussels Exposition. All of the energy was furnished by a Lanz 1000-hp directly connected locomobile and the Wolf 650-hp locomobile shown. Both took grand prizes. The Wolf unit was probably slightly the more economical, due to its double superheating in both the high-pressure and the low-pressure cylinders, and the Lanz superior in valve design for large horse-powers, as the lift valve is essentially the ideal valve for all distribution of superheated steam. Both of these firms have shown extraordinary energy in introducing the locomobile throughout Europe and in pushing it over-sea wherever their natural trade lines go. They have not done much in England, though a large and flourishing English branch, with headquarters in London, is now established by one of these companies. Neither company has made a move in the direction of the United States, possibly fearing our usual prejudice and opposition to anything foreign in the engineering line. When they do come they will be prepared to strike hard.

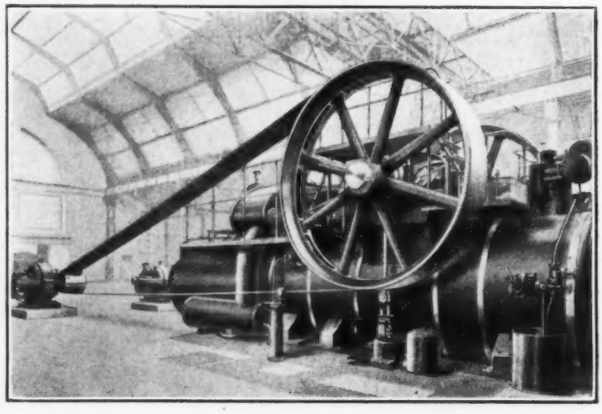


Fig. 5—650-hp Compound Condensing Locomobile at Brussels Exposition.

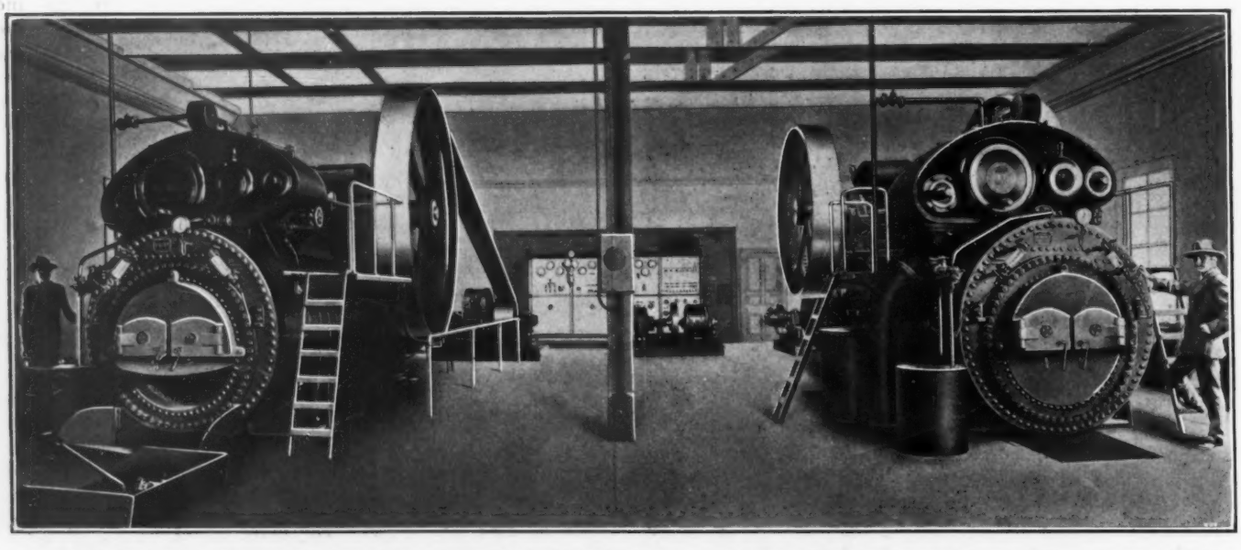


Fig. 4—Two 200-hp Compound Condensing Locomobiles at Antofagasta, Chili, Driving Two Three-Phase 150-kw Alternators in Parallel.

When the locomobile invades this country it will encounter, first, the boiler insurance and inspection crowd, who will have a lot to say about that removable furnace and tubes; and, second, the unions of engineers and firemen in the large cities, as it takes one man's job away from him. However, if our German friends begin with the isolated plant and the Western power station where coal is at a high premium, they will have

plenty to do along these lines before going any deeper into the matter. If a Western mine owner can see that his coal bill is going to be cut down to less than a third he will either assume his own risks or else will take out insurance with German companies that have learned enough about the locomobile to know that it is thoroughly safe.

DISTRIBUTION-LINE CONSTRUCTION IN MINNEAPOLIS.

SPECIFICATIONS for the distribution-line construction used by the Minneapolis General Electric Company were described in a paper by Mr. H. G. Winsor before the Minnesota Electrical Association at St. Paul, March 13.

The poles used are of Idaho cedar, 35 ft. to 65 ft. in length, with 8-in. tops. Butts and tops are treated with coal-tar preservative. The cross-arms are of Washington fir, dipped in preservative. The special eight-pin arms measure 3.75 in. x 4.75 in. and are 9 ft. 8 in. long. The standard four-pin and two-pin arms, in section 4.25 in. x 4.25 in., are 5 ft. and 3 ft. long respectively. Galvanized cross-arm braces are 0.25 in. x 1.25 in. and 26 in. long. For heavy work the following guy equipment is employed: Rod, 0.625 in.; strain insulator, railway type, 1.25 in. x 20 in.; strand, 0.5 in.; average tested strength, 8000 lb. For ordinary work: ¼-in. rod; railway-type strain insulator, 1 in. x 5.25 in.; 5/16-in. strand tested to 4000 lb. For extra heavy guying duty a strain insulator of hard wood, 2.25 in. square and 18 in. long, is used, clevises at each end being held by 0.375-in. through bolts. The tested strength of these insulators averages 15,000 lb. The deep-groove, double-petticoat glass insulators used are carried on pins of first-quality locust. The triple-braid weatherproof wire used ranges in cross-section from No. 6 to 500,000 circ. mil, no wire smaller than No. 6 being used.

In the construction of distribution lines only capable and experienced linemen should be employed and they should have intelligent and careful supervision. Care in laying out the work and the expense of the best of material are of no avail if the construction men are careless or indifferent. A pole improperly set or guyed, or a pit or nick in a wire, due to carelessness, may cause much trouble and possibly injury or death to some innocent person.

Poles are usually set to the depth of about one-seventh of their length, but settings in concrete, rocky soil, etc., may often be safely made at less depth and with perfect security. Some companies use 18 in. to 2 ft. of concrete filling at the top of the hole, finished with a crown raised slightly above the surface to protect the pole from decay at the ground line. This is not necessary, however, where soil has reasonably good drainage and pole butts are properly treated with preservative. Sometimes where extra heavy stress is placed on poles, as in the case of bends in the line, it is well to provide 3 ft to 4 ft. of concrete for strengthening the setting.

In framing the pole and placing the arms the following requirements should be observed: The top arm should be placed not less than 10 in. from the top of the pole, the arms placed below being not less than 2 ft. apart on centers. Buck arms should be placed 12 in. below line arms, and all arms should be fastened to the pole by the use of through-bolts. It is the custom in some places to use spreader brackets in place of buck arms for taking off services and taps, the purpose being economy of space and a provision of safety to linemen. An objection to this method is that the strain is placed on the end of the line arm, instead of on the pole, where it naturally belongs. It is also doubtful if any considerable advantage is gained in additional safety to the lineman.

Double arms, said Mr. Winsor, should be placed at all junction points, at intersections, and at line terminal poles. In framing double arms care should be taken in placing the blocking, and substantial through-bolts should be used in all cases.

Pin spacing on the Minneapolis special eight-pin arm is arranged as follows: Between pole pins, 18 in.; between others, 15 in.; distance of end pins from ends of arm, 4 in. This spacing gives adequate separation for ordinary work.

In the case of lines carrying several wires the location of each particular wire on the arm is of considerable importance. The arrangement advised by the Minneapolis engineers and which is adhered to in all new construction is as follows: A line of single eight-pin arms has city-arc wires on outer or end pins; 2300-volt primaries on next to end pins; three of the four remaining pins are used for three-wire secondaries, leaving one of the pole pins vacant for climbing space. If more than seven wires are to be carried the secondaries are placed on a lower arm. Three-phase power feeders are usually carried on a separate arm at the top of the pole.

In stringing, pulling up and tying in the several wires it is necessary to use much care. The sag should be evenly distributed with due regard for contraction and for the weight of conductors. Care must be especially exercised to avoid nicking when pulling up or making up the ties, particularly with regard to high-tension conductors. Many fatal accidents are due to fallen wires. It is therefore imperative that every precaution be exercised to eliminate defects of every kind.

One of the most important factors in safe line construction is the guying. At junction poles, terminals, and wherever there is a turn or bend in the line, the pole, in addition to its own weight of arms, insulators, etc., which is a vertical load, must also support a much more dangerous horizontal force occasioned by the original tension in the wires and by that due to coverings of ice and sleet.

In making up a guy the strain insulator should be carefully placed to prevent accidents. Clamps with double bolts should be used in all cases where the strand is to be fastened or joined. At the point where the guy is attached to the pole eye-bolts should never be used unless a straight pull can be obtained. As this is rather difficult, the method of wrapping the strand around the pole two turns and fastening with clamps seems very satisfactory.

In locating transformers it is unwise to place more than one transformer on a pole, unless special provision be made for support. In the smaller sizes, say up to and including 10 kw capacity, it is safe practice to support from the line arm. It is best, however, with the larger units to provide special supports in the form of double arms and braces. This also applies where banks of two or more transformers are necessary on the same pole, as in service for two or three-phase power. Single units should always be supported from the central point and not hung out on the arm away from the pole. As a rule the top of the transformer should be hung from the arm which carries the primary mains to which it is to be connected. Connection with primaries should always be made by installing a single-pole pole-type primary cut-out in each leg of the primary circuit. These cut-outs should be fused at about 1 amp per kilowatt of transformer rating, when primary voltage is approximately 2300 volts.

Lightning arresters should be installed on each leg of all primary circuits. They should be inclosed in a box made of non-conducting material, preferably wood, which should be painted or treated with an approved wood preservative. They should never be placed on poles carrying transformers, nor on poles at terminal of lines, but rather on poles next to the ones mentioned. In fastening the arrester to the cross-arm bolts should be used, not screws. To assure usefulness the ground connection must be permanent and effectual, and an active water-main system is the best, and, in many cases, the only dependable point to furnish a satisfactory connection. Where such a system is not available the usual methods of driving pipe or burying a plate or coil of copper can be used. Where the driven-pipe or buried-plate plan is adopted care must be taken to go to a sufficient depth to assure their resting in permanently moist earth.

Systematic and thorough inspection and reinspection of overhead lines is a necessity, and should be done by all com-

panies, regardless of the territory covered. Poles will pull out of position or become weakened at the ground line, causing unequal sag in the wires or adding load where not intended; cross-arms will split, become rotten and allow pins to pull out; pins will decay and break; insulators are good targets for stones or a rifle in the hands of a mischievous boy, or they may break as a result of excessive strain; guys will break down from improper application, overstraining or corrosion; crosses may occur from careless tying in or slipping at insulators; ground wires may become broken and useless, and many other defects are likely to develop. It is quite essential that these faults when they develop should be discovered quickly and repaired as soon as found. A systematic inspection of overhead lines may cause some expense, but it will improve the service, impart a feeling of confidence to both the company official and the public he seeks to serve, and avert many a serious accident.

In closing Mr. Winsor suggested that, if properly instructed, arc-lamp trimmers going about a city or town renewing carbon electrodes might be made useful inspectors of line conditions, making daily reports of all troubles noticed along their routes.

USE OF LOW-GRADE FUEL IN BRITISH PRODUCER PLANT.

IN Europe the situation regarding the use of low-grade coals is not unlike the condition here. The higher-grade fuels are consumed, says Mr. R. H. Fernald, of the United States Bureau of Mines, while trouble is not taken to transport the poorer classes of material away from the mines. The increasing seriousness of this condition is realized, and deep interest is being taken in the possible utilization of low-grade fuels in gas-producer plants. Already one or two such plants abroad are being operated successfully on high-ash fuels.

One 2500-hp plant in Wales uses coal containing 23 per cent ash, 27 per cent volatile matter and 2 per cent to 3 per cent sulphur. The two 1250-hp Crossley pressure-type producers besides supplying gas for four two-cylinder opposed, double-acting engines driving generators for lighting and power about the factory also furnish gas for heating purposes.

At full load the producers are charged and the fire-chambers poked at intervals of one hour to forty-five minutes. The plant force comprises four men on each shift; one chief engineer, two men on the producers and one in the engine-room. The producers are jacketed with asbestos coverings, securing an increase in efficiency of about 5 per cent, it is claimed. A baffle box in the line from the gas generator prevents dust and other impurities from entering and clogging the economizer tubes. Tar recovered by centrifugal extractors is one of the valuable by-products of the plant, selling for $4.25 a ton, and returning a rebate of 19 cents on each ton of coal fired. From the tar extractor the gas passes to two sawdust scrubbers, either of which can be by-passed to facilitate cleaning of the other.

No gas reservoir is used. A small holder, 30 in. in diameter, is tapped onto the gas line entering the engine. When the pressure in this tank is lowered a switch contact is automatically made accelerating the motor-driven blower which provides the blast for the gas generator. Steam for the producer is made in an auxiliary boiler heated by the gases from the producer. By means of this special arrangement for generating steam in a "hot-gas" boiler through the sensible heat of the gases, only a small percentage of the total steam required has to come from the independent auxiliary boiler. When the load is light no steam is furnished by the "hot-gas" boiler, but with full load this boiler supplies about seven-tenths of all the steam required.

The grate in the gas generator is conical and of the revolving type. The continuous removal of ashes is made possible by a water seal. In the operation of the producer the ash bed is kept about 3½ ft. or 4 ft. thick and the fuel bed about 14 ft. thick

One of the special advantages claimed by the manufacturers for this producer is that low-grade fuels containing high percentages of non-combustible matter can be handled successfully. Care must be taken, however, not to use a caking coal.

METER DEPARTMENT NOTES.

By T. B. Morgan.

THERE seem to be comparatively few central-station managers who take an active interest in the meter department and its maintenance, while fewer still are interested in the installation of meters. A good example of neglect of meters is shown by the manager who starts an investigation to determine the cause of an increase to the fraction of a cent per kilowatt generated, while he is losing from 25 kw to 100 kw out of every 1000 kw generated through improperly set or calibrated meters. This loss has come upon the lines so gradually with the spread of the system and the resultant installations of meters that it is attributed to line and transformer loss, which is considered unavoidable under the existing conditions. This type of loss is a double one, first, in cost of production, and, second, in the loss of net profit. To cover this loss high rates must be maintained, and one consumer is paying for the unmetered energy of another.

It is most fortunate for many lighting concerns that the present business conditions, and especially the public-utility boards which exist in many States, are putting a veto upon such a state of affairs, for in the past it has been the cause of loss of consumers and, what is much worse, of creating public opinion against the company. Central stations are themselves beginning to wake up to this fact, and the question of proper methods in dealing with the subject is being continually brought up. As a whole, the central-station management is finding that the public-utility board has done more to increase the revenue of the company than the reverse—first, by calling attention to the condition of meters, where five out of every six are, as a rule, found running slow; second, by insuring to the public a fair and just adjustment of their complaints, and, third, by indicating to the management that when meters are found running slow it is the company's loss and that it represents a loss that may be turned into a clear profit.

There is still a tale of woe circulating among many small central-station men to the effect that the cost of maintenance and periodic tests depletes rather than increases the net earnings, as the gain through accuracy is not held by the meters for a sufficient length of time to recompense the company for actual cost of testing. This may have been true in the old days when this branch of the business was undeveloped, but strides have been made along every line of this work, and should such difficulty be found to-day the trouble will be in the manner in which the work is handled rather than in the meters themselves. It is safe to say that at the present time there is no electric company doing a live business and carrying meters upon its lines which cannot show a proportionate gain in both gross and net earnings by maintaining or assisting in the maintenance of an efficient meter department.

While this may appear to be a broad statement and meet with disapproval at first glance, let those who disagree or are inclined to doubt the assertion look into the matter in an impartial way. For a number of years the large companies throughout the country have collected the major part of their income from the energy sold through the watt-hour meter. It has been proved to the satisfaction of these companies that the maintenance of a meter department is necessary to insure a just return from the consumer, and in turn to insure the consumer a just deal. The Association of Edison Illuminating Companies, one of the largest associations of electric lighting interests in the country, if not in the world, has appointed a committee from its most prominent engineers to investigate and report to the association the most efficient methods of installation and maintenance, and also to report upon the types and efficiency of meters. The National Electric Light Association

and, I believe, the American Institute of Electrical Engineers are looking into the same matter with a view to standardizing meter practice. The first association represents all types of companies and electrical men, while the latter is the acknowledged leading electrical society in the Western Hemisphere. The papers already published by the committees of these societies are of great importance to lighting companies, and a careful perusal of them will show the opinions of the best meter men in the country.

Pass from the opinions of others to your own judgment and consider the watt-hour meter as an instrument. It has a motor which is the lightest and most delicate motor placed upon the wall or other uprights where the old meters had been installed. The meter was then set and leveled, and no meter was left with less than three screws supporting it. In the table below the results of the test upon these meters will be found under "Lot B." The meters tested were manufactured by one company and were one type. They were located in the residential section of the town and their capacity averaged the same. The time between periodic tests in both cases was eleven months, and tests were made by the same men, standards being checked under identical conditions. In fact, the tests and conditions were as nearly identical as could be had under commercial conditions, and the results should have been the

TESTS OF WATT-HOUR METERS ON LIGHT LOAD.

	Under 94% Accuracy.	94 to 96%	96 to 98%	98 to 102%	102 to 105%	105% up	Total
Lot A	(12 not recording) 50	34	50	94	4	7	239
Per cent of total	20.9	14.2	20.9	39.3	1.67	2.92	
Lot B	...	5	7	278	4	1	295
Per cent of total	..	1.69	2.37	94.4	1.34	.34	...

TESTS OF WATT-HOUR METERS ON FULL LOAD.

Lot A	(4 not recording) 12	14	61	139	6	7	239
Per cent of total	5.02	5.85	25.5	58.2	2.51	2.91	...
Lot B	..	..	2	292	1	.	295
Per cent of total	....	....	.68	98.8	.34	....	

commercial market to-day. It must work under all conditions, in any location, and run intermittently for months without oiling or any attention from inspectors. Is it possible to expect it to maintain a high efficiency unless it is treated with care and its location and setting considered with a view of giving it the most favorable conditions to work in?

Many managers of small companies who are anxious and endeavoring to maintain a high efficiency on their systems will find that they can add considerably to their dividends by seeing that the proper location and setting are given to their meters. It is also possible to reduce the cost of maintenance one-third where the meters have been badly set by having a reliable man go over the installations and see that the meters are leveled, trued and firmly set against their supporting walls. While it may be too late to improve the location of the old installations without considerable outlay of money, new installations may be located in a place which will suit the meter as well as the consumer.

To demonstrate the advantage the single-phase induction meter will gain from being properly set a periodic test was made in a district where the superintendent had been too busy to keep track of his installations. Many of these meters had been reported as improperly set by the testers who had run the periodic test eleven months previously, but the limited number of men employed or local conditions forbade the use of time necessary to reset the meters. It will appear at first glance that the tests show fairly satisfactory results until comparison is made with another district. This lot of meters may be designated "Lot A." It contains the test of 239 meters and their accuracy as found. Just prior to this periodic test 295 meters were tested in a district where special attention had been given to the setting of meters. Previous to the installation of induction meters the installations had been fitted with the old type of commutator meters, and when the change was made to induction meters it was found impracticable to change the locations, although there were many poorly located. To overcome bad locations as much as possible special attention was paid to the setting and leveling of the meters. All meters were set on boards which had previously been securely fastened to the same, or very near it. Light-load test was made with one-tenth of the rated amperes given on nameplate, and full load with the rated amperes.

As stated before, these meters were installed in a residential section and it is presumed carried a light load the greater part of the time. Therefore, it is to be expected that loss was really indicated by the light-load test.

The following table is given to show the actual loss on the meters:

LIGHT-LOAD TEST OF WATT-HOUR METERS.

	Meters Registering Under 98c. on the Dollar.	Meters Registering 98c. to 102c. on the Dollar.	Meters Registering Over 102c. on the Dollar.
Lot A	134	94	11
Lot B	12	278	5

FULL-LOAD TEST OF WATT-HOUR METERS.

Lot A	87	139	13
Lot B	2	292	1

The difference shown in the foregoing tables is the result of the setting of the meters. While other conditions might enter in a small degree, they are so small as to be insignificant in the result. It should be borne in mind that this table shows only the loss for one month, while the meters are read twelve times a year.

Anyone wishing to figure the loss to a company will see that unconscious neglect in setting meters is a costly one, and one which is lasting, unless an effort is made to correct it. The management which permits its meters to be carelessly set is neglecting the first principle in maintaining a high efficiency upon its meters and is losing considerable money for its company which should be clear profit.

SLIDE-RULE ERRORS.

By W. L. Durand.

A short time ago the writer was talking on the subject of slide rules with a man who in the course of the conversation said: "I have always wanted to investigate the possibilities of a rule in which the scale is laid off on a logarithmic curve. By this means the divisions would be uniform throughout the entire length of the scale. Then the error would be the same instead of variable, as in the present rule, where the divisions are so much greater at one end than the other."

This remark set me to thinking, and a short investigation served to show that, while the divisions would be uniform, the angle through which the part corresponding to the sliding scale of an ordinary slide rule would have to be moved would vary to the same extent as the divisions on the ordinary rule. Thus a rule of this type would be no more accurate than the present type.

Further investigation showed that the percentage error of a slide rule due to an error of any definite distance in reading is the same at any part of the rule. This can easily be proved as follows:

Let a = first correct reading.

b = first observed reading.

e = first error in actual distance on the rule.

Then, since distances are logarithms of the scale numbers, we have,

$$e_1 = \log b_1 - \log a_1 = \log \frac{b_1}{a_1}$$

Let a_2 = second correct reading.

b_2 = second observed reading.

e_2 = second error in actual distance on the rule.

Then, as before,

$$e_2 = \log b_2 - \log a_2 = \log \frac{b_2}{a_2}$$

Hence, if $e_1 = e_2$, we have,

$$\log \frac{b_1}{a_1} = \log \frac{b_2}{a_2}, \text{ or } \frac{b_1}{a_1} = \frac{b_2}{a_2}$$

Therefore the percentage error is the same in both cases.

For a non-mathematical proof, take a hypothetical case, assuming an error in a 10-in. slide rule of 0.01-in. type. This will mean adding 0.001 to the logarithm of the number.

The log of 2.00 = 0.30103.

Adding 0.001 gives 0.30203.

The antilog of 0.30203 is 2.0046, which gives an error of 0.23 of 1 per cent.

The log of 8.00 = 0.90309.

Adding 0.001 gives 0.90409.

The antilog of 0.90409 is 8.0184, which gives an error of 0.23 of 1 per cent.

In order to determine the accuracy of a 10-in. slide rule, or rather the error in using a rule of this size, the writer took sixty sets of three figure numbers and multipled them first on the slide rule and then on a multiplying machine. The numbers were chosen at random, but so as to take in all parts of the rule, and the answers were such that all parts of the rule were included. The two sets of answers were then subtracted and the ± error determined. The greatest error was 0.15 of 1 per cent and the least 0. The average of all the errors was 0.06 of 1 per cent. There were 29 plus and 30 minus errors and the difference between the sum of the plus and minus errors was 0.60 of 1 per cent. This divided by 60 (the total number of operations) gives 0.01 of 1 per cent as the error for each operation. Where the work consists of only a few operations they may not balance off as well as with a large number; and the probable error for a short series would presumably be greater than the number of figures in the series × 0.01 of 1 per cent.

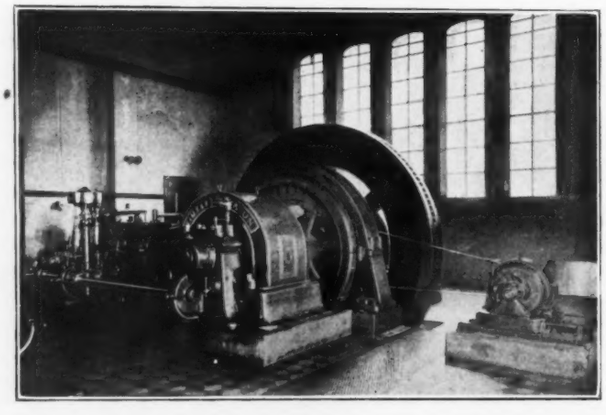
From these figures it is certain that the probable error for any one operation should not exceed 1/10 of 1 per cent and that the probable error for a series of operations should not exceed 2/100 of 1 per cent for each operation. This would mean that, due to the balancing of the plus and minus errors, the error for a series of five operations should not exceed that of a single operation, while for one of ten operations the total error should not be over 0.2 of 1 per cent.

Of course, the personality of the observer enters to a large extent into any determination of this character, and other observers would probably get results either greater or less than those given above; but the order of the figures would be the same and the difference should not exceed 25 per cent.

ELECTRICITY FROM A SWEDISH PEAT BOG.

Several Swedish towns and villages in the neighborhood of Skabersjö, a great modern dairy farm in the Province of Skana, obtain electrical energy for lighting and motor service from a 300-hp gas-engine plant located in the center of the peat bogs of this region. The bituminous material of the peat is converted into fuel gas by suction producers and the gas engines thus operated drive alternators transmitting energy at 3000 volts into the towns. This peat gas-producer transmission system, probably the first installation of its kind, was recently visited by Mr. R. H. Fernald, of the United States Bureau of Mines, and is described in the bureau's newly issued bulletin on the subject of producer plants in Europe, from which this account is abstracted.

The plant equipment comprises two 150-hp suction-type Koerting gas producers, specially designed to burn peat, and two 150-hp twin horizontal-cylinder, single-acting, four-cycle Koerting engines. These engines drive three-phase, 3000-volt



Gas-Engine-Driven Alternator Using Producer Gas from Swedish Peat Bog.

alternating-current generators, the output of which, operating in parallel, is transmitted to Skabersjö and the neighboring towns for lighting and for operating motors in the shops and factories. The residence lighting rate is 9 cents per kw-hour.

The 300-hp plant requires about 4.4 lb. of dry peat for each hp-hour developed, the annual consumption of the producers being 750 tons of the fuel at an average cost of 80 cents per ton. Soft coal in this neighborhood costs $3.75 per ton. The total quantity of peat used during the year is got out of the bog between April 15 and Sept. 1 by fourteen workmen and neighboring farmers, who earn about 50 cents a day. From the bog the peat is shoveled onto a conveyor which is driven by a 35-hp motor obtaining its energy through transformers from the power station. The average depth of the bog is about 7 ft., and at the present rate of digging it will last about fifty years. A cubic yard of the bog deposit supplies about 180 lb. of peat, of which 25 per cent to 30 per cent is moisture.

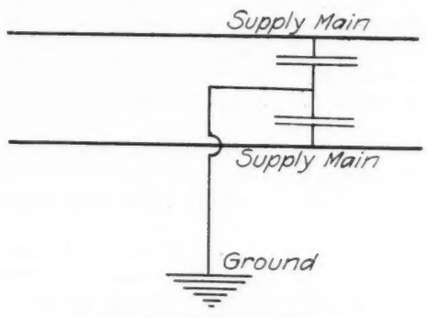
For operating the producer this degree of moisture in the fuel is found to give the best service. With less than 30 per cent present the peat is too dry and steam is required. Fuel is charged into the producers hourly, three men being required during the day shift and two at night. One man supervises the producer-room, one the fuel supply, and the third is stationed in the engine-room. One engine is operated from 5:30 a. m. to 6 p. m., and the other from 5:30 a. m. to 11 p. m.

WIRELESS AS A FIRE HAZARD.

By Elmer J. Lamb.

The use of high-voltage transformers for wireless purposes on the ordinary lighting circuits without the proper protective device constitutes a fire hazard which has been generally overlooked by wiring inspectors.

The supply mains oscillating in harmony with the antenna



Condensers in Wireless Circuit.

of the transmitter carry a static charge which, although harmless in itself, very often may result in serious consequences. As the supply mains and the oscillating antenna approach the same length they come nearer to a state of perfect harmony—that is, they are electrically in tune—and the trouble becomes proportionally more aggravated.

The charge carried by the "live" side tends to ground itself by jumping to the grounded neutral wire, sometimes carrying the low-voltage current with it and establishing a destructive arc.

In case the fixture is a combination electrolier for the use of both electricity and gas the static current is liable to jump to the gas-pipe ground to relieve the difference in potential, carrying the line current with it and setting fire to the insulation. The fire in turn may be communicated to the insulating joint, which is made of an inflammable compound.

The above supposition became a reality in several cases brought under the observation of the writer, the insulating joint taking fire from the resultant arc. Had the fire remained unnoticed for a time sufficient to allow the joint to burn through and let the gas escape what would have eventually happened can be easily imagined.

The trouble is not confined merely to the building in which the transformer may be used, but is strongly in evidence in all places which may be supplied from the same lighting transformer. In many cases, as a result, the voltage coils of the consumers' meters are burned out in identically the same manner as when the lines are affected by lightning disturbances.

This trouble is most conveniently corrected by the use of a small high-tension condenser constructed of glass and tinfoil, arranged in two sections of proper capacity, which must be determined by experiment and is dependent upon local conditions. The condenser should be installed as shown herewith. This arrangement will alleviate any abnormal difference in voltage between the two lines, or between one side and the ground.

A SUGGESTION FOR STAGE SCENERY.

By Albert Scheible.

Under the rigid building inspection laws now enforced in Chicago theaters are divided into different classes according to the fireproofing qualities of the buildings and the supply of exits, only the better equipped houses being allowed to use the old style of scenery. Those barred from using the "drops" which permit of quick changes in scenery in the middle of any act are greatly limited in the range of plays which they can adequately stage, and some of them might do well to profit by an electrical scene-changing effect which removes a drop visually without moving it bodily. How this can be done was shown in a model of the Portland cement plant at Universal, Pa., as exhibited at the recent Chicago Cement Exposition.

The model comprised a panoramic view of the buildings with tracks on which trains with raw and finished materials moved at intervals, all operated by electric motors and nicely lighted by concealed lamps. Besides thus showing the exterior of the plant the interior of the main building was presented about once every two minutes without any shifting or moving of the wall facing the spectators.

To accomplish this the front wall of this building in the model was made of a wire gauze with a mesh of rather fine wire. On this the doors, windows, stone trimmings, etc., were painted so as to match the rest of the picture when lighted from the front. Every two minutes a motor-driven switch turned off part of the lamps so as to dim the light on the scene and then turned on a row of lamps concealed in the building. This made the light inside the structure so much brighter than the outside illumination as to render the interior of the building clearly visible through the wire gauze, just as the landscape is visible through a window screen in the summer. A minute later the inner lights would be extinguished and the outer ones increased in number, thereby exposing the painted and apparently solid outer wall of the building. The same principle could undoubtedly be used on the stage in connection with drops close to the proscenium arch and the adoption of such stationary, yet disappearing, scenery may enable theaters of a certain class to overcome their present handicaps.

NOTES ON COMBUSTION OF FUEL.

By John B. C. Kershaw.

Greater attention to the composition and temperature of the exit gases and also to the training of stokers and boiler engineers is the line upon which progress is occurring in fuel combustion.

The figure given in the heat efficiency diagram for the heat loss with the waste-gases from the boilers, namely, 24 per cent, is, it must be understood, quite an average one. It is based on these gases containing 8 per cent CO_2 and passing away with a temperature of 600 deg. Fahr. In many boiler plants, however, the average percentage of carbonic acid contained in the exit gases is considerably below 8 and on some shifts with bad stoking it falls to 6 per cent. The loss then rises to 32.8 per cent and with chimney gases testing only 5 per cent CO_2 it will be nearly 40 per cent of the total heat generated from the fuel. With a dirty boiler and bad stoking the temperature of the exit gases may also rise above 600 deg. Fahr. and the heat loss be still further increased. The fact

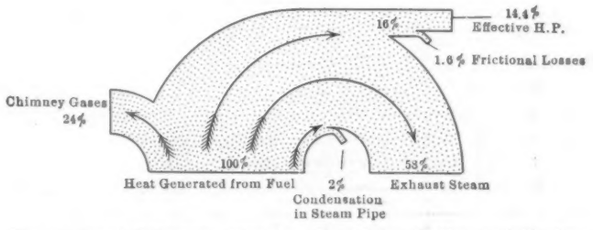


Fig. 1—Heat-Efficiency Diagram for Steam Boiler and Engine.

that the plant is provided with economizers should not cause indifference to this heat loss with the exit gases.

It is wiser and more economical to utilize all the heat one can within the boiler in the conversion of water into steam rather than to allow it to escape, in order to absorb it at a later stage in the economizers. If all the wasted heat were recovered in the latter apparatus the case would be different. The efficiency of economizers, however, rarely rises above 35

per cent and the remaining 65 per cent of the heat passing through them is lost, either by radiation or with the exit gases. As already stated, the writer advises the use of live steam to supply the heat required (after the water has passed through the economizers) to raise the temperature to that of the boiler. In order to obtain the best efficiency from steam-raising plant, therefore, close attention should be given to

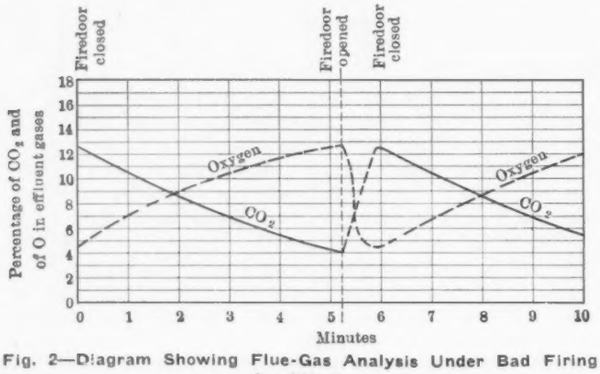


Fig. 2—Diagram Showing Flue-Gas Analysis Under Bad Firing Conditions.

the composition and temperature of the exit gases, and in the best managed boiler houses this is now being done. An average of 10 per cent of carbonic acid with a temperature of 600 deg. Fahr. will reduce the heat loss in the chimney gases to 20.2 per cent, and an average of 12 per cent CO_2 to 17.1 per cent. Still further gains can be obtained by reducing, if possible, the temperatures of the escaping gases. A 10 per cent saving of heat is, therefore, in the majority of plants quite practicable, on the left hand side of the heat efficiency diagram.

It would not serve the writer's purpose to discuss in this article the relative advantages of the various systems of stoking or of the various methods of testing the exit gases for carbonic acid. With care and skilled attention good results can be obtained from any of the well-tried systems and apparatus now in general use. The need is not so much for improved methods and apparatus as for better trained men to handle them. The old idea that any man who can handle a shovel is good enough to fire boilers or to take charge of a mechanical stoker is dying slowly, but it is dying, and stokers are now receiving in many cases better treatment and better pay. Improved results will be obtained in most plants when equal recognition is given to the fact that special knowledge and training are required in the man who is to have charge of, and interpret the results of, the testing apparatus. To obtain

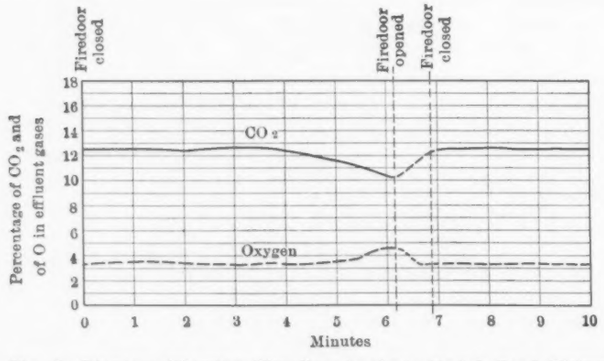


Fig. 3—Diagram Showing Fire-Gas Analysis Under Good Firing Conditions.

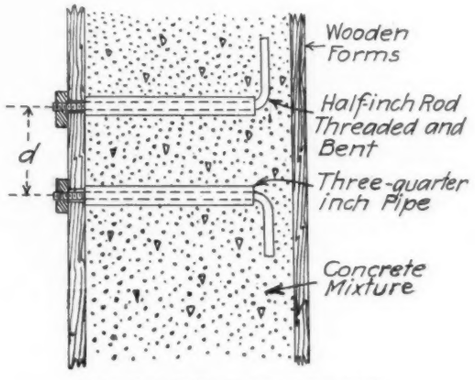
better trained men as firemen is perhaps the greatest need of the moment. The writer is a great supporter of the scheme of training employed by the Hamburg Smoke Abatement Society. This society maintains several instructor stokers who give their whole time to training and supervising the work of the firemen employed by members of the society. The lectures to firemen, such as those given by Mr. W. H. Booth at the Borough Polytechnic, London, are do doubt effecting some good in relation to this matter; but the writer considers the Hamburg system the more practical of the two. The adoption of a bonus system of payment, in which the firemen's wages rise and fall according to the efficiency of their work, as recorded by the CO_2 and temperature tests during each fireman's shift, is also a move in the right direction. As regards the maximum carbonic acid percentage possible, it must be remembered that the danger of working with too high percentages of CO_2 is that incomplete combustion of the carbon and hydrocarbon gases may occur and that carbonic oxide gas, CO, may be formed in place of CO_2. The heat losses due to the formation of only 2 per cent of this gas more than balance the gains due to the difference between 10 per cent and 14 per cent of CO_2. The writer therefore advises engineers in charge of boilers to be satisfied with an average of 10 per cent or 11 per cent carbon dioxide in the exit gases and to frame their bonus scheme on this figure.

The engineer in charge of a small hand-fired steam-raising plant need not consider that large expenditure upon automatic recording apparatus is necessary or essential for the adoption of this system of control. An expenditure of $25 would cover all the apparatus required by the Hamburg system of sampling and testing, and a bonus system of payment can therefore be adopted for installations of only one or two boilers. The chief point to be attended to in obtaining good CO_2 averages is to prevent air leakage through, first, the fire-doors when clinkering and stoking; second, badly pointed boiler settings and brickwork; third, damper openings, and, fourth, defective brickwork in flues. The casing in of boiler brickwork with heat-insulating materials and sheet iron, leaving an air space between the two, is now often done with good results. A cheaper method is to re-point the brickwork and also to paint or tar it every six or twelve months. The snap flue gas tests plotted in diagrammatic form in Fig. 2 and Fig. 3 show the marked effects of good and bad firing on the composition of the flue gases. The results shown in the second series of tests were obtained after the boiler had been fitted with an automatic vane apparatus for regulating the air supply to the demands of the furnace, a most necessary addition to all hand-fired furnaces. The average in the first diagram is 8½ per cent as compared with 12½ per cent in the second; the difference with flue gases passing to the chimney at 600 deg. Fahr. represents a saving in fuel of about 8 per cent. The use of draft gages for recording the volume of air passing through boiler furnaces is now commencing to receive attention. The velocity and amount of the combustion gases are recorded by the apparatus, and from these data the amount of fuel burned and of air used for combustion can be calculated. As proof of the extraordinary results that can be attained by strict regulation of the air supply in combustion processes the new form of laboratory gas burner, known as the Méker burner, may be instanced. This burner yields a homogeneous flame of practically one temperature throughout, the coolest portion of the flame being at a higher temperature than the hottest portion of the ordinary Bunsen flame. The better regulation and distribution of the air supply in this case result in a saving of between 15 per cent and 20 per cent, as compared with the Bunsen form of burner, which for over fifty years has been considered perfect. If to the gains due to the better regulation and distribution of the air supply to boiler furnaces one adds those due to the use of a preheater, most extraordinary efficiencies can be attained with steam boilers. As an example of this one may cite the results obtained at a certain station with a system of force-draft and preheated air supply. In this case the water evaporated per hour per square foot of heating surface was 7.14 lb.; the water evaporated per pound of coal from and at 212 deg. Fehr. was 10.433 lb., and the efficiency of the whole boiler installation, including superheater, was 84.9 per cent. In view of these figures no engineer can say that finality has yet been obtained in the methods of burning fuel under steam boilers.

LETTERS ON PRACTICAL SUBJECTS

CASTING BOLTS IN CONCRETE WALLS.

In mounting high-tension switches, busbar frames, barrier slabs and other parts on concrete walls the job will be far more permanent and workmanlike if during the pouring of the concrete the bolt studs are cast directly into the wall material itself. This can best be done as shown in the accompanying sketch, in which template holes, at the distances and positions of those in the future fitting, are shown bored in the form used to mold the concrete. Then through these holes are clamped the bolts, inclosed in pieces of pipe a little larger than their own diameter, and having their far ends bent into a partial hook, against which to tighten the nut. When the concrete has



Clamping Bolts in Concrete Walls.

hardened and the forms are removed the cleanly threaded bolts are left firmly embedded in the wall in position for the attachment of fittings. The purpose of using the pipe to inclose the bolt is to allow a little play of the bolt for slight variations in the distances between holes in the templates or fittings. If a ½-in. bolt is inclosed in a ¾-in. pipe an adjustment of ¼ in. is possible at each bolt, the shank being easily sprung into the position desired. The pipe also forms a shoulder against which to lock the form template when clamping on the nut before pouring the form.

Gary, Ind. Alex. McCarty.

EXTRA GENERATOR AS ROTARY CONDENSER TO IMPROVE POWER FACTOR.

To the power-station operator with a large motor load the summer season usually means a low load-factor and a low power-factor on his system. Fortunately, however, the same causes place at his disposal means for improving the power-factor of the station generating apparatus by employing one of the extra machines, unused during the summer load, as a rotary condenser to take leading current and thus neutralize the lagging characteristics of the outside load. In a turbine plant containing several units one of the machines which would otherwise be shut down during the season is started under its own steam, brought up to speed and synchronized with the other operating units. The steam valve is then closed and the machine allowed to run as a synchronous motor on the buses, its field excitation being meanwhile raised to a point where it takes a leading or condenser current. This current thus offsets the low power-factor current of the outside load, leaving the working generators to carry nearly unity power-factor load, avoiding overheating by extra-phase currents. Besides correcting the power-factor in the station itself efforts should also be made to improve conditions out on the lines. By making an inspection of the transformer ratings in use, it will frequently be found that some of these transformer sizes can be replaced to advantage by others more nearly suited to the load they have to carry. Load conditions change after the transformers have been installed according to the expected loads of motors and lamps, and in many cases transformers may be found to be underloaded or overloaded, impairing the power-factor. The motor sizes installed on the system should also be looked into, as it frequently happens that the use to which machines are put may be changed, and large motors at first provided are later run underloaded, giving low power-factors.

Chicago, Ill. Richard Owen.

BEHAVIOR OF SOME POP SAFETY VALVES.

Pop safety valves, particularly those of the smaller sizes, frequently give trouble by leaking in a most unwarranted manner. Two small pop valves in particular have given the writer much trouble recently, as they could not be kept from leaking under 150 lb. boiler pressure although the valves were of approved standard make and were stamped for 150 lb. The first valve worked very well for several days. It was attached to a small cylinder in which 150 lb. pressure was maintained for eight hours at a time, then the pressure was removed and the apparatus allowed to remain cold until required for use again. Sometimes this use was immediate, while at other times it would be several days before the safety valve would be used. After fifteen heatings of the cylinder the valve began to leak. It first failed to close sharply after relieving pressure by blowing. Then it refused to seat itself quite completely and slight leakage was observed which constantly increased, hour by hour, and became greater each time the valve operated. The valve was removed and ground with silica sand and water. To facilitate the grinding and testing operations the valve was screwed in a vertical position upon the end of a water pipe in which about 30 lb. pressure (water) was available. Thus it was very easy to test the grinding at any instant by simply allowing water to flow until the sand had been washed out and then applying weight to the valve disk and noting whether any leakage took place beneath it. Considerable trouble was experienced in grinding the valve tight. It was found necessary to finish the grinding with the finest available sand dust and even then to continue rubbing the valve surfaces for some time after all the grinding material had seemingly been removed. This burnished the surfaces and probably filled some of the minute channels or scratches formed by the abrading material. But it was soon found that no matter how well the surfaces were ground together when cold, or how tight they appeared under the slight cold-water pressure, the valve was sure to leak after it had blown once under 150 lb. steam. A new valve was procured, placed on the steam vessel, and was found to behave even worse than the first one. In fact, it was not possible to make this valve tight under pressure by any engineering resource known to the writer. The new valve was never tight and leaked at considerably less than 150 lb. pressure. The writer can find but two explanations for the failure of these safety valves; one that the valve was never ground tight, and the other that the seat or the disk changed shape under pressure. Regarding the first, it is certain that the valve was ground tight, for the reason that it would be tight under 150 lb. pressure until it had blown once, and this same circumstance leads to the belief that the metal changed shape under pressure and heat. This is very noticeable in the cheaper forms of stop valves placed upon the market—the "competition" valve is an example of this kind—and as these valves are made very light indeed, even below the limit, they are not able to withstand even ordinary low pressures; consequently such valves are never tight after having been used once. The writer has decided views in regard to the influence of heat upon the copper and zinc alloys from which valves are made. The action of low degrees of heat is very noticeable upon one of the metals—the zinc—and while this metal in ingot shape is very brittle at ordinary atmospheric temperatures it becomes quite ductile when heated to 150 deg. Fahr.

to 200 deg. Fahr., and becomes even more brittle when heated to higher temperatures. It then becomes more and more brittle until it melts. Even then the tension is greatly decreased by a little more heat, for if the heat becomes greater the zinc is soon ignited and is dissipated in the form of oxide. It is to be presumed that a certain somewhat similar change takes place in the alloy of zinc from which the valve disk is made, and as the heat or temperature due to steam pressure of 150 lb. is about 366 deg. it looks as if the designers of safety valves should increase the factor of safety used in dimensioning disks and seats.

South Bend, Ind. JAMES F. HOBART.

TROUBLE WITH INTERPOLE MOTORS.

It is a well-known fact that the good performance of an interpole motor is dependent upon the exact brush position far more than is that of the common shunt or compound motor. Some trouble lately encountered with a number of small interpole motors brings this out remarkably well. All of the motors were of the same type, being 1-hp variable-speed, bi-polar, compound-wound interpole motors directly connected to the head-stocks of wood-turning lathes. The speed variations were from 800 r.p.m. to 2800 r.p.m., the first steps being controlled by armature resistance and the later steps by field-circuit resistance.

The motors were started up by means of a rheostat, which left the motors running at 800 r.p.m. Then, as they were speeded up, some of them would stop at the 1600-r.p.m. point and reverse at approximately the same speed, while others would do the same thing when passing from 2600 to 2800. It was then found that the motors that reversed at 1600 r.p.m. would not reverse until they reached the 2600-r.p.m. point if they were speeded up very slowly. These particular motors, it was discovered, had no oil in the bearings. Upon being oiled they could be rapidly speeded up to the 2600 point, where, like all the rest, they would reverse. After making a number of tests the conclusion was reached that the brush position was wrong. This proved to be the case, for after putting the brushes back (opposite to the rotation) about one bar the trouble was entirely remedied.

The internal magnetic actions that take place are very interesting and are as follows:

In any motor when the brushes are ahead of the neutral point, as they were in the first place, the armature reactions are less than normal and consequently the resultant field is stronger than usual. The result is that at each successive point the armature falls more and more below the designed speed.

As the counter e.m.f. in an armature is directly proportional to the speed there is a proportional decrease in the counter e.m.f. and a proportional increase in armature current which results in a very strong armature field, the strength of which is greater than the proportional increase of armature current.

The higher speeds being obtained by field control, it is found that at the last point the field m.m.f. due to the field winding is very weak and the armature m.m.f. very strong, due to the low counter e.m.f. The consequence is that the pole-pieces were demagnetized and then magnetized with opposite polarity, which caused the motor to reverse. This reversing, as would be expected, was accompanied by sparking at the brushes due to the interpole polarity being wrong for the reversed rotation

Philadelphia, Pa. R. W. WILBRAHAM.

CONSTRUCTION OF FOUNDATIONS FOR ELECTRICAL MACHINERY.

Foundation bolts are used to tie machines to the foundation. The types of bolts most commonly used are shown in Fig. 1. For medium and large-sized machines the bolts required are so long that commercial standard bolts of the necessary length are not ordinarily available. Therefore, a threaded rod having a nut on both ends is used, as shown at *A* and *B*, Fig. 1. Another reason for using a rod having a removable nut at both ends is that in certain applications the bolts must be removable from the foundation. In such cases, after the lower nut has been taken off, the bolt can be withdrawn. Foundation washer pockets are required where foundation bolts must be removable. The bolts of *A* and *B*, Fig. 1, are inclosed respectively in an iron pipe and in a wooden box casing. Casings are described in detail in following paragraphs.

If foundation bolts for a given application do not exceed, say, ⅝ in. or ¾ in. in diameter, standard commercial bolts of sufficient length can, ordinarily, be readily obtained. Such bolts can be either set in casings similar to those shown at *A* and *B*, Fig. 1, or they can be set directly in the concrete or masonry as indicated at *C*, Fig. 1. When a bolt has a knee formed in it (*C*, Fig. 1) it is known as a bent bolt. The deformation prevents bolts from turning in the masonry if they happen to be loosely set and it also greatly increases their resistance to withdrawal. The angle in the knee is usually made about 90 deg. and the apex of the bend is offset about three diameters. The knee should be formed well toward the bottom of the bolt, so that if a great stress is imposed on the bolt there will be no possibility of the knee straightening and breaking out the concrete at the surface. Bent bolts are widely used in structural steel construction for tying columns to footings. Commercial, unbent, wrought-iron bolts are frequently set in concrete without being altered in any way. However, a cast-iron washer should be slipped on before the bolt is set. Bolts thus arranged give entire satisfaction if judiciously employed.

It is not at all necessary to deform or to have a nut or washer on the lower end of an iron rod set in concrete to develop the full strength of the rod. The rod must, however, be set to a certain depth, as will be shown. Mild bolt steel has an elastic limit of about 25,000 lb. per square inch and will yield excessively when stressed in excess of that value. The adhesive strength of concrete to round iron bars is from 250 lb. to 400 lb. per square inch of exposed bar surface for round steel bars, where d = diameter of bar in inches and l = length in inches of the bar embedded in the concrete. Taking the lower value for adhesive strength: The adhesion, in pounds, between the bar and concrete $= 250\,\pi\,dl$; the supporting power of the rod, in pounds, when stressed to the elastic limit $= 25{,}000\,\pi\,d^2 \div 4$. Then, if a rod be embedded to such a depth that its supporting power is just equal to the adhesion between it and the concrete: $250\,\pi\,dl = 25{,}000\,\pi\,d^2 \div 4$, or $l = 25\,d$. That is, the rod must be embedded a length equal to twenty-five times its diameter. Such a rod would pull out just as it became loaded to 25,000 lb. per square inch. It should be noted that in the above demonstration it is assumed that the rod is not threaded. A threaded rod is obviously weaker than an unthreaded one. Foundation bolts are always threaded. Therefore, the quantity $25\,d$ is somewhat liberal for foundation bolts. The letter "*d*" in the demonstration indicates the outside diameter of a rod—not the diameter at the root of the thread.

Inasmuch as the strength of bond between a rod and concrete is a somewhat uncertain factor, plain rods, to develop their full strength, should for safety be embedded a distance somewhat over twenty-five diameters; thirty diameters is believed to be a conservative figure. For reinforced concrete work it has been authoritatively recommended that the safe adhesive strength between round rods and concrete be taken as 75 lb. per square inch of exposed surface.

Where two or more small foundation bolts lie close together they are sometimes connected at their bottoms with a length of angle or strap iron (Fig. 1, *D*). Where such a connecting piece is used short bolts can be utilized, because an enormous force would be required to effect the failure, through shearing through the concrete, of such an arrangement. A connecting piece also retains the bottom ends of the bolts in correct relation with each other while the concrete is being poured. Either threaded rods or standard bolts (Fig. 1, *D*) can be used.

Sometimes foundation bolts must be inserted in a foundation or in a masonry structure where no provision was made for them during construction. In these cases holes must be drilled with a hand or a power drill, the bolt inserted and a cement of some sort poured in around it as indicated at *E*, Fig. 1. It

is said to be the regular practice in some mining districts in the West to build foundations for machines without foundation bolts intentionally. When the machine is received it is mounted on the foundation and the holes for the bolts are drilled, using the machine bedplate as a templet. It is claimed that where air drills are available this is a very economical and satisfactory method of securing the machine.

Usually either sulphur, lead or cement is used, as indicated at *E*, Fig. 1, for holding the bolt in a drilled hole. To ascertain which of these three materials was best suited for securing bolts in holes experiments were conducted as follows: Fourteen holes were drilled in a ledge of solid limestone. Seven were

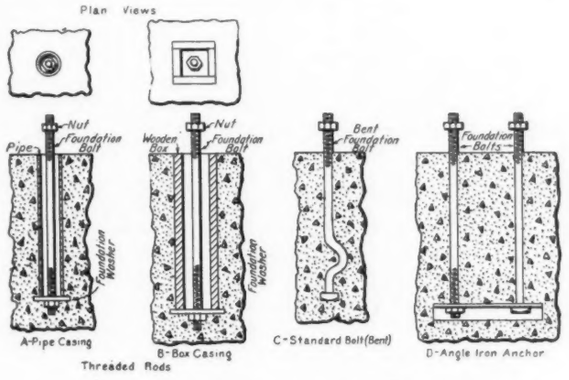
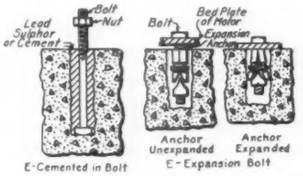


Fig. 1—Various Forms of Foundation Bolts.



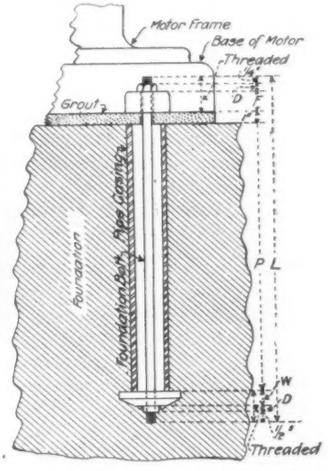


Fig. 2—Foundation-Bolt Dimension.

1⅜ in. in diameter and seven were 1⅝ in. in diameter. All holes were 3½ ft. deep. Fourteen bolts, plain at the lower end and having a nut at the upper end, were cemented in the holes as indicated in the following table. All of the bolts were ragged for 3½ ft. at their lower ends. All were permitted to stand until the cement was two weeks old. Then they were pulled with a lever. The results were as follows:

Bolt Set in	¾ In. Bolts in 1⅜ In. Holes.	1 In. Bolts in 1⅝ In. Holes
Sulphur		
1	Developed full strength, 16,000 lb.	
2	Developed full strength, 16,000 lb.	
3		Pulled out under 12,000 lb.
4		Developed full strength, 31,000 lb.
Lead		
1	Developed full strength, 16,000 lb.	
2	Developed full strength, 16,000 lb.	
3		Pulled out under 13,000 lb.
4		Developed full strength, 31,000 lb.
Neat Cement.		
1	Broke without pulling out.	
2	Broke without pulling out.	
3	Broke without pulling out.	
4		Broke without pulling out.
5		Broke without pulling out.
6		Commenced to yield at 26,000 lb. but sustained load a few seconds and then broke.

While these experiments do not indicate the adhesive strengths of the materials in pounds per square inch, they show conclusively that cement is the best of the three. It is the most reliable and the strongest and should therefore be used where possible. It is not necessary that a "cemented-in" foundation bolt have a head on it as has the one at *E* (Fig. 1). The head greatly increases its resistance to pulling out, but if the bolt be inserted thirty diameters into the cement the full safe strength of the bolt will be developed.

Expansion bolts, one type of which is illustrated at *F*, Fig. 1, are occasionally used for attaching small machines to existing masonry. If of sufficient length and properly installed they stand well under static loads, but cannot be recommended for the varying, vibrating loads imposed by machinery unless the machines be small and the bolts large.

Summarizing, the applications of different types of foundation bolts may be classified as follows: Rods threaded at both ends are used for foundation bolts (*A*, Fig. 1) when a commercial headed bolt of sufficient length cannot be obtained or where, when used in a foundation with pockets, the bolts must be removable from the foundation.

Standard commercial headed bolts can be used where it is not necessary that they be removable from the foundation, either bent (*C*, Fig. 1) or straight if they can be obtained of sufficient length.

Connecting straps can be used with either threaded rods or standard bolts (*D*, Fig. 1) when the bolts lie close together in the foundation. The strap increases the resistance to withdrawal.

Cemented-in bolts can be used where it is necessary to attach a machine to an existing foundation. Either plain rods, sufficiently long to develop full strength, or standard headed bolts (*E*, Fig. 1) can be used.

Expansion bolts can be used for the attachment of machines of small capacity.

Foundation bolts that are to be set directly in concrete are sometimes slightly deformed by "bruising" or by threading them along the part that is to be set in the concrete. Tests indicate that little or nothing is to be gained by threading. Bruising or nicking probably increases the resistance to failure somewhat, but it is usually considered better and cheaper to use a bolt sufficiently long than to use a shorter one and hack it full of notches. Once it was a popular practice to slot the lower end of a foundation or anchor bolt made from a rod and insert a cotter through the slot. This cotter rested against a washer. In modern construction the rod is usually threaded at both ends and a special washer, which engages with a square nut, is arranged at the lower end. The modern method is preferable in that it is cheaper and in that the bolt is more readily prepared.

Although, from the standpoint of resistance to withdrawal, a bolt set directly in concrete need extend into the concrete only thirty times its diameter, it is ordinary practice to extend the bolts almost to the bottom of the foundation unless the foundation be exceptionally deep. This is also the practice with bolts arranged in casings, as shown in Fig. 4. The reason for this practice appears to be that there is a possibility in some cases of a whole top stratum of a green foundation being cracked off by vibration and tension unless the foundation bolts extend well down into it. Probably the practice originated with brick and stone masonry foundations laid in weak mortar, which were not as strong as modern concrete ones. It is necessary that bolts set in casings (*A* and *B*, Fig.

1) be reasonably long so that they will have sufficient flexibility to enable their top ends to be shifted to any part of the mouth of the casing. This is required to permit moving the tops of the bolts when the machine supported is being aligned.

It is difficult to suggest a rule for determining proper burial lengths of foundation bolts. They must be set deep enough so that there can be no possibility of their failure by withdrawing due to the cracking out of the concrete or to the lack of sufficient adhering surface exposed to the concrete. An empirical rule that has been largely used and appears to have given satisfaction is as follows: A foundation bolt should extend into the masonry a distance at least equal to fifty of its diameters, or P (Fig. 2) $= 50d$. This rule has been used for bolts set in casings and for those set directly in concrete. The outside diameter and not the diameter at the root of the thread is indicated by d.

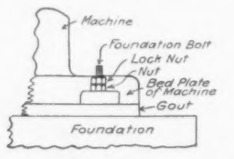


Fig. 3—Application of Lock Nut.

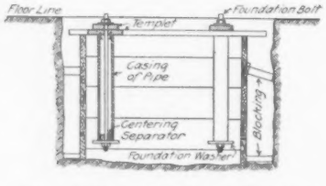


Fig. 4—Form Ready for Pouring.

To determine the over-all length L (Fig. 2) of a foundation bolt several increments must be added to the nominal buried length P. At the top end the increments are (1) a clearance of at least ¼ in. above the nut; (2) the thickness of one nut or of two nuts if lock nuts are used; (3) the thickness F of the machine bedplate or foot through which the bolt passes, and (4) at least 1 in. for grout. At the bottom the following must be provided for: (1) the thickness of the washer W; (2) the thickness of one nut, and (3) a clearance of at least ¼ in. The shop drawing for a foundation bolt indicates only its length, diameter and the distance, or distances in the case of a threaded rod, to be threaded.

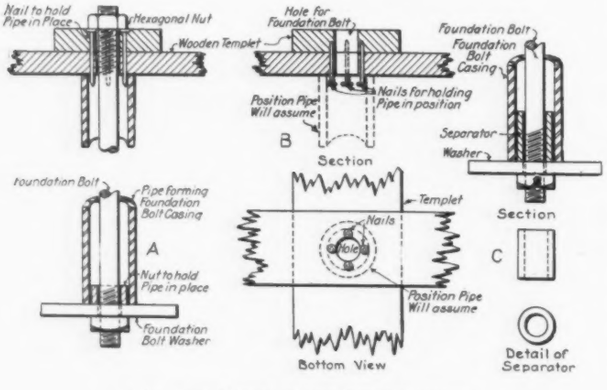


Fig. 5—Methods of Centering Casings.

Diameters of foundation bolts are usually determined by the size of the foundation-bolt holes in the machines which they are to secure. Hence the diameters are really determined by the machine builders. A working clearance must be allowed in every case and, taking this into consideration, the largest diameter bolt that will enter the hole is selected. A diametral clearance of ⅛ in. is used for bolts ⅞ in. in diameter and smaller; a ¼-in. clearance for 1-in. to 2½-in. bolts, and ⅜ in. for 2¾ in. bolts and larger. Sometimes smaller clearances than those indicated are used where there is every assurance that the bolt holes in the machine frame will be drilled accurately in accordance with the outline drawing submitted by the machine builder. Some of the electrical manufacturing companies recommended diametral clearances as small as 1/16 in. for bolts as large as 1¼ in. The safe load for foundation bolts may be taken as 10,000 lb. per square inch. When calculating the strength of a rod that is threaded the effective area, that is, the area at the root of the thread, must be taken. Lock nuts, as indicated in Fig. 3, are frequently used on foundation bolts, but are not always considered necessary. The additional nuts cost but a trifle and it is believed that in almost every case their use is justified. Casings are provided for foundation bolts so that the tops of the bolts can be shifted slightly to allow for the alignment of machines and so that the bolts can be made to enter bolt holes in bedplates that are inaccurately located. With pocketed foundations casings also provide a vertical hole through which the foundation bolt can be dropped. The internal diameter or width of the case of a square casing is usually made equal to the diameter of the bolt plus two times the diameter of the bolt ($d + 2d$). The length of a casing (P, Fig. 2) is equal to the distance from the top of the foundation to the top of the washer.

Where it can be so arranged it is convenient to have the bottom face of the foundation-bolt templet lie in the same plane as the top of the foundation, as illustrated in Fig. 4. Then the bolts and casings can be suspended from the templet. The washer is located in its correct position on the bolt and the casing clamped in tightly between the templet and the washer (Fig. 4). It may be necessary to insert blocking between the top face of the templet and the top nut to clamp in the casing effectively. If the casing is made and clamped as described the concrete can be poured without its being necessary to take elevations on the tops of the foundation bolts. The casings locate the bolts as to elevation. If the casings are accurate as to length the bolt tops will extend exactly the right distance above the face of the finished foundation. The form shown in Fig. 4 is ready to be poured and the bolts and casings are suspended in it in the manner described. Where foundation bolts are to be removable and the foundation is pocketed, a casing cut correctly to length determines the elevation of the top of the pocket and accurately locates the wooden piece that constitutes the top of the pocket form.

A casing around a bolt suspended from a templet should lie concentrically with the bolts while the concrete is being poured. Some methods of centering applicable to either square or round casings are outlined in Fig. 5. At A a nut dropped into the casing over the bolt serves to center the bolt's lower end. Nails driven through the templet secure the top of the casing. At B the nails are driven from below instead of from above. They can be accurately inserted with their heads tangent to and inside of (concentric with the bolt hole) a circle of the diameter of the hole through the pipe. At C a wooden hollow cylinder is used at the bottom of the casing instead of a nut. A round piece of board with a bolt hole bored through it satisfies every requirement.

Casings are sometimes merely wooden boxes without ends, as shown in Fig. 1, B. Lengths of drain tile and vitrified sewer pipe have been used. Small casings, those under, say, 1½ in. internal diameter, are usually of wrought-iron pipe. Larger ones are often formed from sheet iron. Ordinary leader pipe can be used, but if the stock from which it is made is too thin it may crush when the concrete is being tamped in. About old plants there is usually discarded wrought-iron pipe which has only a junk value. This makes admirable casings that cost little.

Pittsburgh, Pa. Bruce H. Page.

QUESTIONS AND ANSWERS

In electrical contracting work how is the cost of work usually estimated? P. O. J.

In ordinary work the cost is apportioned with a fair degree of accuracy as follows: Labor, 40 per cent; conduit, 22 per cent; wire, 18 per cent, and incidentals, switches, outlets, etc., 20 per cent.

What are the standard rate of wage and the working hours of electricians in this country? D. I. N.

There is no generally recognized standard. In New York City the contractors' agreement calls for an eight-hour day, the working hours being between 8 and 5. Work before 8 or after 5 and after 12 on Saturday and work on Sundays and legal holidays is subject to a double rate. The number of helpers must not exceed the number of journeymen on the job. A journeyman receives $4.50 a day; second-year helper, $2.20 a day, and first-year helper, $1.50.

Will there be any difference in the steam consumptions of two cross-compound engines directly connected to generators carrying 500 kw each, one operating at 100 per cent power-factor and the other at 80 per cent power-factor, their speed, voltage and all other conditions being the same? S. A.

The efficiency of a machine delivering 500 kw is somewhat greater when the power-factor is 100 per cent than when 80 per cent, and therefore the input in the former case would be slightly less than in the latter case. Thus the engine driving the former generator would consume less steam than the engine driving the latter. However, the difference would be relatively inappreciable.

The National Electric Code distinctly specifies the relative positions and accessibility of the cut-out, switch and meter. In many of the devices now on the market designed to protect the electric light company against theft of energy the rules are not always observed. Is it permissible to use these devices under such conditions? K. E.

At a meeting of the Underwriters' National Electric Association in 1909 a committee appointed on "theft of current" reported that in its judgment there was a need of recognition in the code of service and other special devices for preventing theft of energy and recommended that the switch and cut-out committee classify such apparatus. The majority, if not all of these devices, have been approved by the Underwriters.

When two 1000-kw, three-phase alternators are operated in parallel and the field circuit of one of them is opened, will they fall out of step or drop the load? If the field circuit is reversed on one of them will they still remain in parallel? H. I.

So long as the generators remain in parallel the division of load between them is not affected by the variation in the field strength. However, not many alternators are built with such synchronizing ability that they will remain in step at full load with no field current. That is to say, if the field circuit of one of the machines is opened it will probably drop out of step. In certain instances, however, the generators may remain in step, and under these conditions will divide the load just as though the field strength was properly adjusted. Even when a negative value is given the field current such a machine may continue to remain in step and carry its share of the load.

In case it is necessary to apply two motors for the driving of line shafting in an industrial establishment, is it proper to divide the line shafting in two parts, or to belt the two motors to the same shaft? B. E.

Assuming that shunt-wound motors are to be employed, it can be stated that when the motors are mechanically so connected that they must operate at relatively the same speed the division of load between them will depend largely on the resistance in the armature circuits of the two motors and except for this fact will be independent of the specific ratings of the two machines. In other words, the load-speed characteristic of the one motor should be identical with that of the other if the two are to divide the load equally between them. When this is not done the motor with the better speed regulation becomes more quickly overloaded than the other motor. Resistance should be placed in the armature circuit of this motor in order to cause the other motor to assume its proper share of load.

How much iron would be needed for a transformer to be used in reducing the e.m.f. from 110 volts, single-phase, 60 cycles, to from 35 volts to 45 volts, and from 30 amp. to 40 amp? What size wire will be needed and what will be the weight and number of turns? How can the speed of series motors be increased? Is aluminum wire used for magnet windings? Does it have to be insulated when used as magnet wire? R. O.

The cross-sectional area of the core should be about 10 sq. in. The transformer should be wound with 110 turns of No. 8 wire and 45 turns of No. 4 wire. There will be required about 45 lb. of iron and 15 lb. of copper. At full load the copper loss will be about 60 watts and the iron loss about 45 watts, the efficiency being probably 93 per cent. The speed of a series motor already constructed can be increased most conveniently by placing a shunt around the field coils. If the motor is well designed it will withstand such an adjustment, but if poorly designed it may be inclined to spark. Magnets are sometimes wound with aluminum wire without insulation. The oxide which forms on the surface of the aluminum is sufficient to withstand the small e.m.f. impressed between adjacent turns.

Where a central station can install only one circuit for lamps and motors, the system being three-phase, is it best to operate a three-phase, four-wire system with different voltages on the lamps and motors, or to operate a plain three-wire, three-phase system having the same voltage on the lamps and motors? Is a three-phase watt-hour meter accurate when measuring a single-phase load? L. L.

Where the motor load forms only a small part of the total output from a station it is preferable to arrange the circuits with reference primarily to the requirements of the lighting load, causing the motor to adjust itself to these requirements. Where the motor load is relatively large it is best to install separate circuits for the motors and for the lamps. In only a few cases is it desirable to install a four-wire, three-phase system having one voltage for lamps and another voltage for motors. Unless a three-phase meter registers accurately on unbalanced loads it is very probable that it will not register accurately with balanced loads. The maximum of unbalance occurs when the load is purely single-phase, but a properly adjusted three-phase watt-hour meter should register a single-phase load accurately.

What is the ratio between the loads that can be carried by two transformers connected in open delta and by the same transformers used separately in single-phase circuits? R. G.

The comparison can be best explained by a simple illustration. With three transformers connected in closed delta, each carrying 10 amp, the current in each lead wire is 17.3 amp, and the voltage between wires is that produced by each transformer, while the total power output is the sum of the power delivered by the three transformers. If one of the transformers is removed, leaving the other two in open delta, the currents in the other two transformers would be increased to 17.3 amp, but the power would remain the same as before. However, the two transformers would be greatly overloaded, the heating effect in the coils of each being three times as much as formerly. If the currents were reduced in each to 10 amp in order to reduce the heating to the normal value, then the actual power would be reduced to 57.7 per cent of its former value. If, for example, each transformer was designed for 10 kw, under normal conditions when used in a delta three-phase group, the total output would be 30 kw; with the two transformers in open delta with 300 per cent heating in the coils the output would still be 30 kw, while with the two transformers in open delta with normal heating the output would be 17.32 kw. With the two transformers used single-phase the output with normal heating would be 20 kw.

Central Station
Management, Policies and Commercial Methods

ELECTRIC ROCK DRILLS SUPPLANT AIR DRILL IN HARD-ROCK TUNNELING.

The contractors engaged in excavating the tunnel for the Canadian Northern Railroad entering Duluth, Minn., after going part way through the mountain struck an extremely hard granite-like formation of igneous rock, which, unlike granite, does not chip and so has to be drilled all the way. For this purpose the compressed-air drills in use soon proved unequal to the severe work required of them. Four electric-operated drills, in which revolving hammers deliver 1800 blows a minute on drill points rotated at 70 r.p.m., were then secured, and with these progress of 50 ft. per month has since been made continuously, which will enable the contractors to finish their work on schedule time, besides making up the time already lost. Four additional electric drills have also been ordered to assist in the work of tunnel construction. This demonstration of the electric drill's superiority and speed over its older compressed-air counterpart is especially interesting when it is recalled that these electric drills take only 2 hp each, while the compressed-air drills, without reheating of the air, required about 14 hp per drill to drive the air compressors. The electric drills are operated from the contractor's camp electric plant at the site of the tunnel about six miles from Duluth.

CUSTOMERS' EMERGENCY REPAIRS BY CONTRACTORS.

The Electric Illuminating Company, of Cleveland, Ohio, does no emergency repair work for its customers, but maintains a call service by which in response to a customer's request for assistance a repairman is at once dispatched from the contractor's shop nearest the location of the trouble. For this purpose the city is divided into a number of districts, one for each of the electrical repair shops co-operating in the emergency service. When a customer telephones to the central-station company's office that his washing machine, flatiron, fan or other electrical appliance is out of order, and expresses no preference regarding who shall make the repairs, his name and location are taken down and immediately referred to the contractor in the same district of the city. The latter can then send a man without delay to the scene of the trouble, which is usually in his near neighborhood.

The contractors co-operating in this emergency repair service run a combined advertisement in the Cleveland "People's Electrical Page" in the newspapers, giving the name, address and telephone number of each, together with a statement of the uniform schedule for repairs charged by all—70 cents per hour for the workman's time, plus the cost of material used.

ELECTRICAL ICE-MAKING IN LATITUDE 49 DEG. NORTH.

The utility of making artificial ice by means of electrical energy does not appear to be limited by geographical location or low mean annual temperature. The City Dairy & Produce Company, of Vancouver, B. C., has just installed a motor-driven Triumph compression system with a capacity for making ten tons of ice daily. The Canadian Fishing Company, at Vancouver, also operates a similar motor-driven 42-ton refrigerating plant. Vancouver is in north latitude 49 deg. and is several hundred miles more northerly than any city in the United States.

ELECTRIC-VEHICLE CAMPAIGN AT LOUISVILLE.

Mr. Roscoe Woltz, power engineer and electric-vehicle expert for the Louisville Lighting Company, of Louisville, Ky., is arranging in booklet form battery-charging instruction matter for users of electric vehicles, with the idea of making electric-vehicle performance in that city even more satisfactory than ever before. Where necessary the company offers free the advice and assistance of its expert to aid any electric-vehicle owner. Supplementing this campaign of instruction for present owners of cars, advertising matter calling attention to the advantages of the electric automobile is being spread in the Louisville papers and in the company's own publication, *Chained Lightning*. About seventy-five electric vehicles are now in use in Louisville. The Louisville Lighting Company accords these its power rate for charging purposes, which is equivalent to 5 cents per kw-hour unless the monthly bill exceeds $8, in which case the rate is 4 cents. The Kentucky Electric Company, which also has a number of vehicle-charging stations on its lines, makes use of an off-peak rate, with time switches which prevent the taking of energy during the peak period.

"SAVE MONEY BY USING ELECTRIC LIGHT."

During the recent Minneapolis Electric Show the Minneapolis General Electric Company distributed thousands of small savings banks on which was printed the appropriate legend "Save money" and below this "by using electric light." The little banks were made out of pasteboard cylinders with tin heads, one of which was slotted to receive coins up to the size of a quarter. The souvenirs were appreciated by the public, and in almost every case were carried home. Along with them went the following house-wiring arguments printed on the label:

"Electricity makes the home beautiful, cheerful and inviting; safe, lessening danger of fires and burglary; healthful—electric light cannot affect the air; convenient—use it anywhere, any time, as much as you want.

"Electricity will do your work in the sewing-room, laundry, kitchen and elsewhere.

"Wiring the house involves no tearing up of furnishings, and, with our new lamps, your lighting bills are cut in half."

RESIDENCE SERVICE IN DULUTH.

The number of houses in Duluth, Minn., with a population of 80,000, is estimated by Mr. C. E. Van Bergen, manager of the Duluth Edison Electric Company, to be about 14,000. Of this number 12,000, or more than 85 per cent, are customers of the central-station company. The latter has thus 2000 more customers than the 10,000 water connections listed and 5000 more than the number of gas consumers, although the water and gas plants are both municipal, gas selling for 75 cents per 1000 cu. ft., with a 25-cent monthly minimum bill. The electric company has also established the same minimum bill. From 0.2 kw to 0.3 kw of transformer rating per residence customer is now found to be ample. During the last two years the Duluth company has made a special effort to have all the better class of residences wired for both a lighting and a heating meter, with very satisfactory results. Nearly all medium-sized residences and many small houses are thus equipped. For all energy used through the heating meter (to which may be connected electric ranges, radiators, vacuum cleaners and irons) the company makes a rate of 3 cents per kw-hour, less

20 per cent for prompt payment, with a minimum bill of $1 per month. Notwithstanding the 75-cent gas rate, the electric company has installed during the last year a dozen electric ranges and a number of electric grates and radiators.

ADDITIONAL MOTOR-DRIVEN WATER-WORKS PUMPS FOR DULUTH.

To the present electrically operated main water-works pumping station of the City of Duluth, Minn., which has a daily delivering capacity of 20,000,000 gal., bonds have been voted to add new motor-driven equipment capable of delivering 30,000,000 gal., bringing the total rating of the station up to 50,000,000 gal. per day. Additional motor-driven booster pumps will also be installed at various points of the distribution system. The energy used by the Duluth water works is developed at the St. Louis River hydroelectric plant of the Great Northern Power Company, which now receives $6.50 per 1,000,000 gal. pumped, or the equivalent of about $0.0045 per kw-hour for this off-peak 18-hour service. The main pumping units operate against a hydrostatic head of 290 ft., to which is added 30 ft. friction head.

DAY CIRCUITS ESTABLISHED THROUGH ELECTRIC-IRON CAMPAIGNS.

In these columns instances have several times been cited showing how, in the case of small central-station companies operating only night lighting circuits, the inauguration of Tuesday-morning electric service for the use of electric irons has later been followed by the establishment of profitable full-day service and the securing of local shop and factory motor loads. Municipal water-pumping, ice-making, sale of steam to local industries, such as laundries, etc., are some of the other central-station auxiliaries which make such day-service operation possible and profitable.

Several instances where at first partial and later full-day service was established as the direct result of electric-iron campaigns were mentioned by Mr. J. D. Cross, heating-appliance expert for the General Electric Company, Chicago, in a discussion on the subject of day loads for central stations at the St. Paul convention of the Minnesota Electrical Association, March 15.

When Mr. James J. Roe, manager of the Hampton Electric Light & Power Company, Hampton, Ia., was considering running his plant Tuesday mornings for ironing-day service Mrs. Roe called up a number of her friends on the telephone, told them about the plans and of the conveniences and advantages of the new irons, and enlisted their interest in the new departure to the extent of getting the promise of each to try the irons for a number of Tuesday mornings. Seventy-five electric irons were soon connected to the lines, and the plant was operated half a day each week to serve them. The customers were at once pleased with the convenience of the new service, but soon demanded more than merely one day's operation, volunteering to use a certain amount of energy each day of the week if full-day service were furnished. Mr. Roe then yielded to these importunities, started twenty-four-hour operation and now has a profitable motor load, besides additional heating appliances, in his little city of 3000 inhabitants.

Crown Point, Ind., is one of the few places where a day motor circuit was established and later abandoned on account of the invariable discouragements of the first few months' operation. In this instance the company, after feeling that its day service was conducted at a loss for three months, disconnected its customers' motors, bought them back at the sale price and was endeavoring to return them to the manufacturers when Mr. Cross laid before the company a proposal to try the Tuesday-morning day-circuit plan that had proved successful elsewhere. One hundred irons were at once placed, and fifty more were ordered in the course of the next few months. The ironing-day service grew of itself profitable and the customers were well pleased. They, together with the original motor customers, who had been greatly disappointed at the withdrawal of service before, then insisted on the re-establishment of every-day operation. The heating-appliance results have now convinced the company that this can be done to advantage, and the same motors once taken out are now being put back into place and day service will be commenced at once. During its recent Tuesday-morning operation the same company has been transmitting energy twenty miles over a high-tension transmission line each ironing day to obtain the revenue to be derived from the twenty or thirty irons in the distant community to which it supplies lighting.

TUNGSTEN LAMPS IN DIRTY PLACES

It has frequently been urged in favor of tungsten lamps when they have displaced arc lamps that they require less attention in the shape of trimming. While it is of course true that they require less attention, and that their efficiency is considerably higher than the common inclosed carbon arcs in use at the time the tungsten lamp came into the field, it may nevertheless be equally true that the fact that the arc lamp requires frequent trimming and cleaning is a positive gain to the purchaser of light rather than a detriment. In many establishments lamps are likely to be absolutely neglected as far as cleaning is concerned, unless there is trimming required. The tungsten lamp makes a fine showing as compared to the old arc lamps when it is first installed and cleaned, but we have seen many installations where dirt has been allowed to collect on tungsten lamps, so that most of the supposed advantages in efficiency have been wiped out. However, it is a mistake to suppose that when an arc lamp is trimmed its globe is necessarily cleaned. Attention which is ordinarily given to trimming and cleaning of arc lamps is insufficient to obtain the best results. Not a few arc-lamp installations which are supposed to be in good shape show remarkably poor results when actually tested, simply because of lack of adjustment and cleaning.

DOMESTIC HEATING-APPLIANCE EFFICIENCIES.

At its March meeting in Chicago the North Shore Electric Company Section of the National Electric Light Association was addressed by Mr. Charles P. Madsen, engineer for the Pelouze Electric Heater Company, Chicago, on the subject of "Domestic Heating Appliances."

Electric irons, said Mr. Madsen, constitute by far the most important part of the domestic heating appliances manufactured, sold and used. While all electric heating appliances and electric irons have, of course, an efficiency of 100 per cent in heat production, their efficiency of utilization in delivering this heat to the working surface ranges from 30 per cent to 60 per cent in the case of various modern types. This efficiency may be tested with fair accuracy by inverting the iron and placing on its upturned surface a can of the same shape as the iron containing a known quantity of water. Measuring the temperature rise of this water due to the expenditure of a given amount of energy in the iron will enable the latter's utilization efficiency to be computed. Temperature measurements of the top, side and bottom surfaces, using well-known radiation constants for obtaining the heat output at each part, also enable a fair determination of efficiency to be made. Other tests are by immersing the working surface in a known quantity of water, clamping the iron to a mass of metal, etc., in each instance measuring the heat input into the material heated.

Of almost equal importance with the efficiency of an iron for domestic use is its starting speed, or the time taken to reach an ironing temperature of 500 deg. at its bottom surface. The ideal iron quickly reaches a high temperature on its bottom, without wastefully heating the top and side surfaces.

Starting speed can be tested by standing an iron upright and affixing pieces of wax to its top and bottom surfaces. The relative times required before the two pieces drop give an indication of the starting speed of the iron. The best record was obtained with an iron which melted loose its bottom-side wax ball in ninety seconds, while the wax on the top adhered for fifteen minutes. In a less efficiently designed type of iron, in which the heating element was farther from the bottom and was required to warm first a large mass of material besides penetrating several air-gaps, eight minutes was required after turning on the circuit before the bottom wax melted, while the top wax dropped off two minutes later.

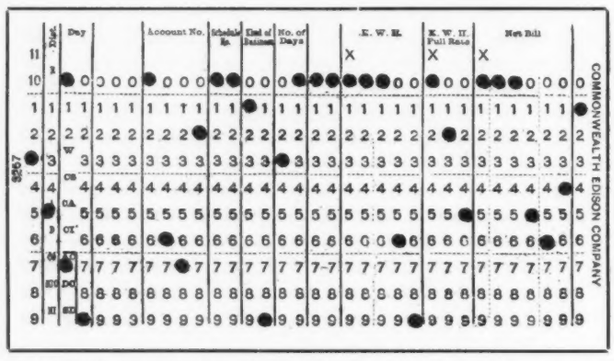
In discussing electric cooking and water-heating devices Mr. Madsen urged against solicitors making unfounded claims and guesses about the work which a given heater will do. The failure of the apparatus to "make good" the pretensions thus assumed for it always results in a dissatisfied customer. The service a given water heater will actually render can be computed as follows, if the efficiency of heat application of the device is known: To raise one pint of water from room temperature to boiling about 3000 watt-minutes would be required for a device having 100 per cent efficiency. Disk stoves range in efficiency from 30 per cent to 73 per cent, and the above energy expenditure must be increased inversely proportionately to the efficiency figure of the heater used. To raise a pint of water to be merely "hot," 175 deg., the temperature for tea-making and coffee-making, 2320 watt-minutes are required. A 250-watt disk heater of 100 per cent efficiency would accomplish this result in nine minutes, but as the best heater made has an efficiency of 73 per cent, at least twelve minutes will be required.

TABULATING MACHINES FOR CHECKING BILLS AT CHICAGO.

The Commonwealth Edison Company, Chicago, was one of the first central-station companies to make use of the Hollerith tabulating machines, and has had several sorters and tabulators in use for four years. Besides the preparation of the large amount of statistical work done by this company an important use is made of the machines in checking the extensions of each of the 130,000 customers' lighting and power bills before these are sent out each month.

As is well known, the Chicago company employs a double-rate schedule, charging 12 cents net (13 cents with 1-cent discount for prompt payment) for each kw-hour up to thirty hours' use of the maximum demand during the month, beyond which all additional consumption is charged at the rate of 7 cents gross or 6 cents net per kw-hour. The meter department furnishes the accounting department with the customer's consumption and demand during the month, which is entered in the customer's billing card and the amount of his bill figured, adding the high-rate and low-rate portions to find the total amount. The billing clerks then transfer these figures to the bill forms, making out the accounts in the usual way. When finished, the amounts of these customers' bills are listed and summed on an adding machine and held for checking with the Hollerith punched data cards.

These Hollerith data cards are then also prepared from the customers' billing cards from which the bill forms were filled out. The data card used by the Commonwealth Edison Company carries columns denoting the month of the year, district, day of meter reading, account number, rate schedule used, business of consumer, connected load in kilowatts, a blank extra column, total kw-hours consumed during month, kw-hours used at full rate and net amount of bill. After the cards have been punched they are run through the sorter and separated by rate schedules, all the cards coming under, say, the 12-6-cent schedule mentioned being taken to the tabulating machine, the counters arranged to add the columns "Kw-hours used," "Kw-hours at full rate," and the amount of the bill. As the full-rate portion is charged for at 12 cents per kw-hour and the low-rate portion at 6 cents, obviously an equivalent operation for computing the amount of the double-rate bills is to add the product of the total kw-hours multiplied by 6 to the full-rate kw-hours multiplied by 6. The sum thus obtained should check with the total of the customers' bills read on the other counter of the tabulating machine. After the different schedules are checked the cards are summarized by light and power kw-hours consumed and income, the grand total of which equals the total obtained by the listing machine. When



Tabulating Card Used by Chicago Company Perforated for Small Residence.

a discrepancy is found to exist, smaller numbers of bills are taken and similarly compared until the error is located. As the result of this system of checking, the extension and billing clerks and the punch operators are all able to work much more rapidly, without the necessity for extreme care in going over and rechecking their work, which is later done mechanically and speedily. This also checks the Hollerith cards for statistical data, in addition to checking the extensions.

Some of the interesting results obtained by the Commonwealth Edison Company's statistical department with these tabulating machines were presented in a paper by Messrs. G. A. McKana and B. F. McGuire, entitled "Significance of Statistics," read before the 1910 convention of the National Electric Light Association at St. Louis. A reproduction of the former card form used by the Chicago company is given in that paper. This type of card has now been replaced by a smaller card with single spaces between vertical columns, making it more compact to handle. Several columns appearing on the old card have also been dispensed with. The new card is shown herewith.

The machines now in use by the Commonwealth Edison Company comprise two sorting machines and three tabulators, the latter each arranged to add one three-digit, one five-digit and one six-column field. The average operator can punch 200 cards an hour with an error of less than one-half of 1 per cent. The sorting machine separates 250 cards a minute into eleven classifications, while the tabulators add 150 cards per minute.

This method of analyzing central-station customers' accounts is also in use in New York, Brooklyn, Boston, Minneapolis, Denver and by the Washington Water-Power Company, but the Chicago company is the only one, perhaps, employing the card system for checking bill extensions. The system has also been used at Chicago to study employees' data, ages, salary, length of service, etc.

SIX THOUSAND LUMINOUS-ARC LAMPS FOR CINCINNATI.

Bids have been advertised and contracts will be let in April for 6000 or 7000 luminous-arc lamps with rectifying equipment for lighting the city streets of Cincinnati. When placed, this order will be the largest single purchase of luminous-arc equipment ever made, comprising more than 125 75-lamp rectifier transformers and sufficient lamps to illuminate the entire city,

replacing the present inclosed-arc lamps. The specifications provide for 4-amp magnetite or metallic-flame arc lamps to replace all existing city arc lamps at street intersections in the outlying overhead district and at 133-ft. intervals in the downtown section, except on certain streets where incandescent curb lighting may be required. The new lighting contract on which bids are invited will remain in force ten years from June 1, 1912. As evidence of good faith, all bids must be accompanied by certified check for $100,000. At the present time the Union Gas & Electric Company, of Cincinnati, holds the street-lighting contract. The specifications for the new street lighting describe in detail matters of metering, penalties, and other points relating to the supply of energy for the large number of luminous-arc lamps, 800 clusters and 3000 tungsten lamps which the city is expected to use. The specifications were prepared by Mr. J. H. Sundmaker, director of public service for the City of Cincinnati.

EXHAUST STEAM HEATING AS DEVELOPED BY A LARGE CENTRAL LIGHTING STATION.

By E. Darrow.

Most American citizens can look backward and can recall the time when fireplaces and stoves were considered very satisfactory as heating systems. Methods used a few years ago and considered satisfactory then are now obsolete. Concentration of population has developed new conditions for living and business and the watchword of our large corporations is "economy."

The Merchants' Heat & Lighting Company, of Indianapolis, has developed an extensive system of exhaust-steam heating, which covers the entire business district, and steam is supplied to points more than two miles from the power stations.

Apartment buildings, hotels, business blocks, office buildings, schools and residences are demanding that the responsibility

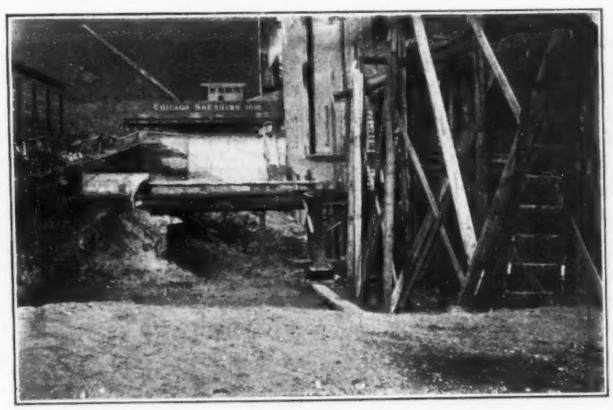


Fig. 1—Steam Line Leaving Station.

and necessary expert attention for the operation of isolated plants be transferred to the specialist—that is, the central-station man.

The chief advantage of a central-station supply of heat is in the economy of exhaust steam. The one principal objection has been that it necessitates heat transmission through a system of conduits, which in the past has been a wasteful process, but in the system as developed by the Merchants' Heat & Light Company steam is distributed through a system of pipes and conduits, more than fifteen miles in all, together with necessary service connections, and the losses are less than 10 per cent.

There are now nearly 400 central-station companies supplying heat, and the awakening to this important adjunct is just beginning. The central-station man should appreciate what it would mean to his soliciting department if he could send men to the large department stores, hotels, theaters, apartment buildings, schools, libraries and public buildings and offer to furnish light, motor service and steam for all heating purposes and hot water as needed.

Ninety per cent of the hotels, theaters, department stores and large buildings have availed themselves of this privilege in Indianapolis, and hundreds of smokestacks are now smokeless, the result being a cleaner and brighter city.

The solicitors have found the following form very advantageous in getting new business. The operator is asked to fill in the yearly costs of his isolated plant, which he can do if his heating costs have been properly kept.

MONTHLY LEDGER ACCOUNT—ITEMS CHARGEABLE TO ISOLATED PLANTS.

OPERATING EXPENSES.	
Superintendence	$
Wages, engineers and engine attendance	
Wages, firemen and coal passers	
Fuel	
Cost of removing ashes	
Water for boiler	
Repairs to engines	
Repairs to boilers	
Repairs to generators	
Repairs to belts	
Repairs to steam elevators	
Repairs to hydraulic elevators	
Repairs to pumps and miscellaneous machinery	
Incandescent lamp renewals	
Arc lamp electrodes	
Arc lamp globes	
Arc lamp repairs	
Miscellaneous expense, oil, waste, packing, etc.	
Insurance—fire and boiler	
Total account, operating expenses	$
FIXED CHARGES.	
Interest on plant investment, 5 per cent.	$
Depreciation on plant investment, 7 per cent.	
Rental value of space occupied by plant	
Decreased rental value of space made less desirable by heat of plant in summer	
Taxes on plant	
Risk of damage to employees and public through accident	
Total account, fixed charges	$
Total cost for maintaining plant, per month	$

The Merchants' Heat & Light Company has been in the steam-heating business nine years and the past year has seen the greatest demand in its history for its steam service. Close to 1,000,000 sq. ft. of radiation is now supplied and the service is so uniformly excellent that not one customer has ever left the lines because of dissatisfaction.

The Merchants' Heat & Light Company supplies lighting, motor service and heat from two central plants; one to the east of the business center of Indianapolis and the second and larger on the White River one mile west of the business center. That the engineering conditions may be better understood a brief outline of the equipment of the plant is inserted here.

The east plant has four 300-kw, 250-volt generators driven by compound non-condensing engines and three 850-kw, 250-volt generators driven by non-condensing turbines; the steam is generated in seven 300-hp boilers and four 600-hp boilers. In the east plant there are two 1000-kw non-condensing turbine units, two 850-kw condensing turbine units and one 4000-kw generator driven by a cross-compound Corliss engine which can be run either condensing or non-condensing; the steaming equipment consists of twelve 510-hp and four 600-hp Stirling boilers.

These two plants are connected by a 20-in. steam line from the east plant and a 30-in. line out of the west plant. The 30-in. line, which is inclosed in a reinforced-concrete tunnel, is shown in Fig. 1 leaving the station and entering the tunnel. Fig. 2 shows the insulating covering being applied. It consists of 1.5 in. of asbestos, wool felt and tarred paper. Fig. 3 relates to details of pipe construction in tunnels, showing the location of manholes, anchors, expansion joints, etc. Fig. 4 shows the

construction as developed by the Merchants' Heat & Light Company for building pipe lines in sizes of 20 in., 15 in., 12 in., 10 in. and 8 in. It consists briefly in replacing the concrete tunnel with sewer tile, split longitudinally and cemented together after pipe and insulation are in place. This construction has proved very durable, of excellent insulating value and easily built and maintained.

TABLE I.—SPLIT-TILE CONSTRUCTION COST, INCLUDING TRENCHING AND PAVING.

Size in Inches.	Cost per Foot.
20	$19.50
15	14.75
12	12.35
10	9.50
8	8.40
6	6.85
4	5.25

The heating and lighting company maintains its lines to the curb and requires that the consumer own and maintain all

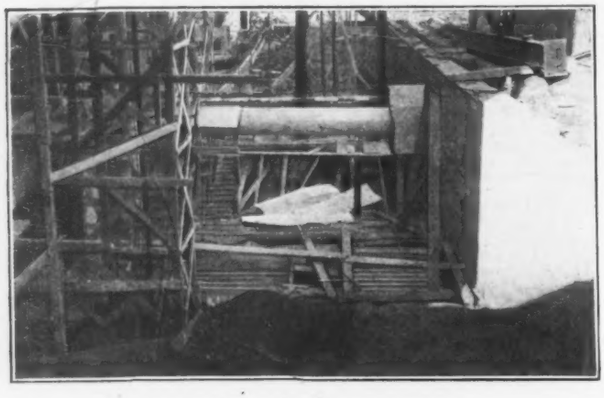


Fig. 2—Steam Line Being Covered.

pipe, regulating devices and fittings within the curb line and building served.

The company's contract provides that the consumer shall attend to two very important details: First, at the point where service enters building there is installed either a Powers regulator or a "Sylphon Regitherm" control valve. The first of these is operated by compressed air and the second by a mechanical device, so that when the temperature at an agreed point reaches 70 deg. Fahr. the steam pressure is diminished automatically. Second, on each system served there must be placed a cooling coil or hot-water radiation sufficient to reduce the condensed steam from 212 deg. Fahr to 100 deg. Fahr.

The minimum charge per season is 20 cents per square foot of radiation required. The above meter rate approximates very closely to a flat-rate charge of 30 cents per square foot per heating season of eight months.

From the very first advocates of central-station heating have had the opposition of certain consulting engineers and manufacturers of engines and turbines, and it is only when they have been forced by their clients that they have recognized and accepted the facts and data obtained by workers in the field of central-station heating.

TABLE II.—RATES FOR STEAM SERVICE.

Consumption per Month. Pounds.	Rate per 1000 lb. of Condensed Steam.
First 10,000	$0.80
Next 40,000	0.75
" 50,000	0.70
" 100,000	0.65
" 100,000	0.60
All over 300,000	0.50

TABLE III.—ANALYSIS OF COSTS.

Coal cost, per ton	$1.20
Water, per 1000 gal.	0.04
Firing and boiler maintenance, per ton	0.20
Evaporation from Indiana coal, lb. per lb.	0.06
Manufacturing cost of steam, per 1000 lb.	0.122
Total extra station cost	134.20

Let us take another view of operating results.

TABLE IV.—COST IN CENTS PER 1000 LB. SOLD.

Production cost	0.122
Distribution cost	0.013
Collections	0.002
General expense	0.015
Insurance, taxes, damages	0.017
Depreciation	0.050
Interest	0.050
	0.269

The old argument was used continually that condensing units operate on 18 lb. to 20 lb. of steam per kw-hour, whereas a back pressure of 5 lb. requires a steam consumption by the engines of from 40 lb. to 50 lb. per kw-hour. A hasty consideration of the above by a skeptic would be convincing, but it is well to analyze the result obtained in the west plant of the Merchants' Heat & Light Company, bearing in mind that this plant is so arranged that every pound of steam generated can be used for exhaust steam heating or can be condensed as required. This plant has a daily electric load-factor in excess of 50 per cent and during the winter months has a daily output of 45,000 kw-hours. Indiana nut, pea and slack coal is burned, which does not average over 9500 heat units per pound. The cost of this fuel under the boiler is $1.30 per ton.

Concerning the revenue of one day's output, both condensing and non-condensing, in either case there is 45,000 kw-hours to sell, for which, based on switchboard meters, the price may be assumed as 4 cents per kw-hour, or $1,800 per day electric revenue. It may be assumed that under condensing conditions the steam consumption is 20 lb. per kw-hour, or 900,000 lb. in twenty-four hours.

Under non-condensing conditions for the same period, when exhausting into the heating mains against 5 lb. back pressure, the average steam consumption per kw-hour is 45 lb., or a total of 2,025,000 lb. Then the added revenue from sale of steam at an average price at plant of 50 cents per 1000 lb. is $1,012.50 per day, or a total plant revenue of $2,812.50.

It will be seen that with the heating system on it required

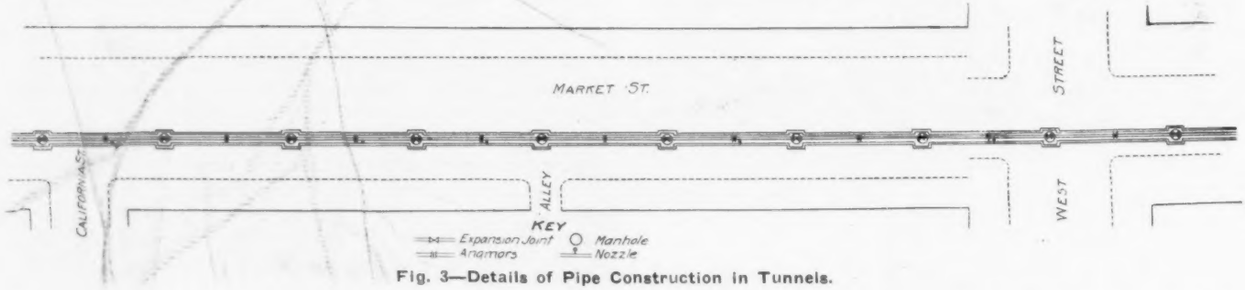


Fig. 3—Details of Pipe Construction in Tunnels.

1,100,000 lb. more steam to produce 45,000 kw-hours than when condensing.

With steam netting an average of 50 cents per 1000 lb. at station, there is a net profit of 23 cents per 1000 lb. See Table IV.

A third consideration of this particular heating system is that the revenues from sales of steam pay for the entire fuel bill (electric and steam) for twelve months, all power-house maintenance and labor and 10 per cent on entire investment in street piping and services.

Fig. 5 shows the relationship between outside temperature and heating-main pressure (back pressure) as determined by experience on this system and is for the guidance of the chief engineer during changing weather conditions.

Fig. 4—Typical Cross-Section of Steam Main.

In conclusion it may be stated that there are many reasons why it is advantageous for central stations to undertake exhaust steam heating. When a central station is able to supply heat the strongest argument for an isolated plant is taken away. In order to get the light and motor-service business the central station must also take the heating business.

Most large central stations, having secured the bulk of small light and motor-service business, have now reached a point where further development depends upon their taking on business of a larger character and their ability to supplant isolated plants.

Equipped to supply heat the central station is in a position to forestall the installation of isolated plants. Again, the central station can balance the isolated plant electric and steam load and can offer a reliability of steam and electric service which the isolated plant cannot give.

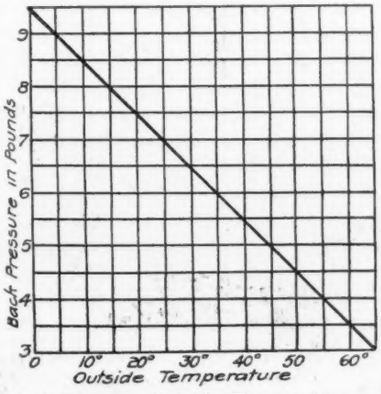


Fig. 5—Relation Between Outside Temperature and Heating-Main Pressure.

And, lastly, the central station, which originally was designed for lighting only, then later added motor load, and now seeks heating, is a powerful factor in smoke abatement and cleaner and brighter cities. Hundreds of smoking chimneys have been put out of business by the Indianapolis central stations, which with their modern stoker-fired boiler plants scarcely show a haze above the stacks, even when developing tens of thousands of horsepower.

Wiring and Illumination

SIGN LIGHTING IN LOUISVILLE, KY.

In the matter of electric signs the streets of Louisville, Ky., are probably as well equipped as any city of its size in the country. Several professional sign companies have aided the efforts of the local central-station companies in putting signs into service, and, besides the great number of small merchants' signs, many spectacular displays are in operation. Mr. A. T. Macdonald, general traffic manager of the Louisville Lighting Company, estimates that at least 100,000 sign lamps are in use in Louisville, in 1000 different signs, and that these signs have cost to install about $200,000. These figures afford some idea of the stable basis on which electrical advertising has been placed in the Kentucky city.

Fig. 1—Electric Signs in Louisville, Ky.

The Louisville Lighting Company has used several attractive spectacular displays on a Fourth Street roof sign, calling attention to central-station motor service. One of these, similar to that in use by the St. Louis company, showed a piece of iron thrust into a motor-driven grindstone, with an attendant display of sparks. The present central-station spectacle depicts a motor-driven power punch. Motor pulley, belt and wheel rotate, and as the punch descends sparks are seen to fly in all directions. The idea has been artistically and faithfully worked out, with the company's own legend prominently displayed.

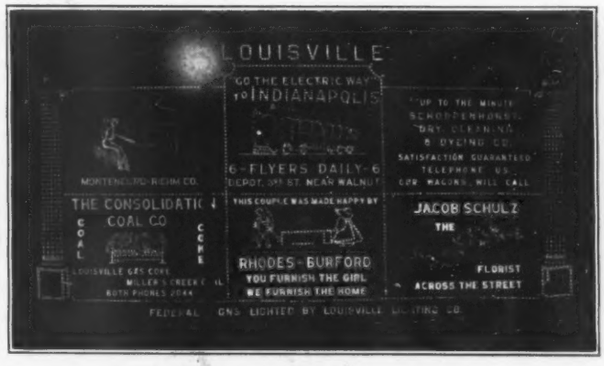


Fig. 2—Electric Display Sign at Louisville, Ky.

The chief electric sign feature in Louisville, of course, is the huge display, 60 ft. by 100 ft., fronting on Federal Square near the post office on Fourth Street. This huge sign, containing nearly 6000 lamps, is divided into six 20 ft. by 30-ft. panels, each of which is rented to advertisers for $80 a month. The electric car shown in the center of the illustration by a flasher arrangement is apparently in motion, with wheels turning, track flowing behind it and trolley emitting faint green sparks. The little folks in the panel below are shown walking. The upper left-hand panel shows a young lady playing a piano and below

is a realistic, flickering coal fire in a grate of electric lamps. The sign is thus a scene of animation, without the misguided application of flasher effects which—fearful to relate—set the huge columns at the sides spinning wildly on their axes while the gentle scrolls of their Corinthian capitals are made into fiery pinwheels.

Other attractive moving displays in Louisville are those representing a pool player with cue and ball movements shown in lamps, a bubbling glass of liquid refreshment, a man tipping his hat and the significant arrow of a soda fountain drink.

The city streets of Louisville are lighted by 2500 magnetite luminous-arc lamps, installed several years ago, this being the first large-scale use of these lamps made in an American city. There are 15,000 consumers of central-station energy in Louisville.

ORNAMENTAL STREET LIGHTING IN FORT WAYNE.

Tungsten lamps will be used for the ornamental street lighting of Calhoun, Berry, Main and Court Streets in Fort Wayne, Ind., according to a resolution adopted by the Board of Public Works of that city recently. The matter has been under consideration by a committee of business men which has advised with the city officials. The committee considered both tungsten lamps and magnetite arcs, but preferred the former. The new lamps will be installed on attractive posts and there will be five on each block. The adjacent property owners will pay for the installation, and the city will maintain it. Each post will support five 60-watt lamps.

FREIGHT-YARD LIGHTING.

By W. S. Austin.

At Dupo, Ill., about thirteen miles southeast of the St. Louis Union Station, on the St. Louis, Iron Mountain & Southern Railroad of the Missouri Pacific Railway System, is located one of the largest double-hump freight yards in the West, designed to handle both north-bound and south-bound traffic, each hump having a capacity of 120 cars per hour. The yard is about three miles long and about 800 ft. wide at the classifying yards, with connections to the railroad company's Illinois Division, East St. Louis, Ivory Ferry, the Terminal Railroad Association and other systems. The yard is divided into receiving, classification, forwarding, storage, caboose and repair yards. The two humps, the roundhouse, repair yards, coal and water stations and the power house, together with a hotel and other facilities, are located at practically the longitudinal center of the yard, making it very nearly symmetrical.

Fig. 1—Freight Yard at Dupo, Ill., by Night.

Under the direction of the construction department of the Missouri Pacific Railway Company, Westinghouse, Church, Kerr & Company, in 1906, acting as engineers and constructors for the Railway Company, designed, constructed and equipped its Dupo power house. The following year the engineers were instructed to investigate and recommend a system of artificial illumination for the yard. All of the commercial systems of outdoor arc lighting were investigated, but as the power house contained alternating-current equipment, the direct-current systems could not have serious consideration. Owing to business conditions, all work in the yard was suspended from 1907 to 1909, in the fall of which year the subject was again taken up; and as many improvements had been made in different lighting systems, another investigation and report were made, which included flaming arcs, in addition to the systems previously considered.

Several installations of flaming arcs were visited in and around New York, including those at the Bush Terminal yards, the New York Central yards and a foundry installation. In a portion of the foundry the carbon arcs, which the flaming arcs had superseded, had not been removed, making it possible to study the effect, intensity and quality of light produced by both systems by using first one system and then the other.

Tests made showed that in direct sunlight an 8-in. high white chalk figure made on a brown background with a ½-in. diameter crayon could be read up to 275 ft., and that on a dark night with the flaming arc the same figure could be read at a distance of from 100 ft. to 150 ft., depending upon the position of the board with relation to the lamp. Under the same conditions with carbon and other white-light arcs the figures could not be read more than one-half the distance possible with the flaming arc. This had an important bearing on the selection of lamp, as in operating the humps it is necessary that the men in the switch towers at the entrances to the classification yard shall be able to read the car numbers at a distance of from 100 ft. to 175 ft. in order to throw the proper switch in front of the approaching car.

A detailed investigation and study showed the candle-power of the flaming arc to be greater than that of any other type, and that the quality of light generated by it was better suited for

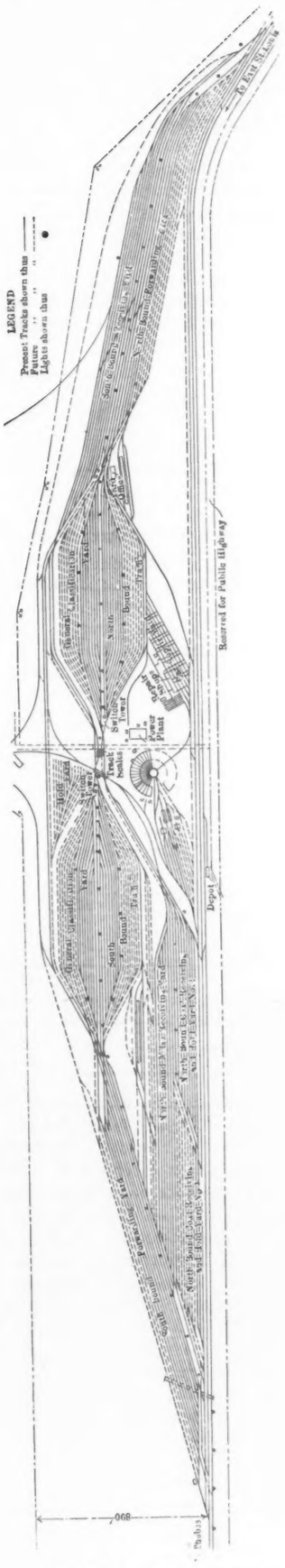


Fig. 2—Plan of Freight Yard.

this installation than that produced by any of the other lamps, as the penetration in clear weather, as well as in smoke and fog, was greater than with any of the other types, with the further advantage that the unshaded lamps would not blind or dazzle the eyes of the switching crews while working around the yard, even though they looked directly at the lamp or beyond it, thus making it unnecessary to provide expensive and complicated reflectors and shades.

A comparative study of the different kinds of flaming arcs was made to determine reliability, freedom from interruption, length of burning between trims, cost of operation, repairs, maintenance, etc., with the result that the regenerative flaming arc, manufactured by the Adams-Bagnall Electric Company, was recommended for this installation.

Fig. 2 shows the outline of the yard and spacing of tracks, as well as the approximate location and spacing of lamps. The lamps are spaced most closely around the humps, the distance

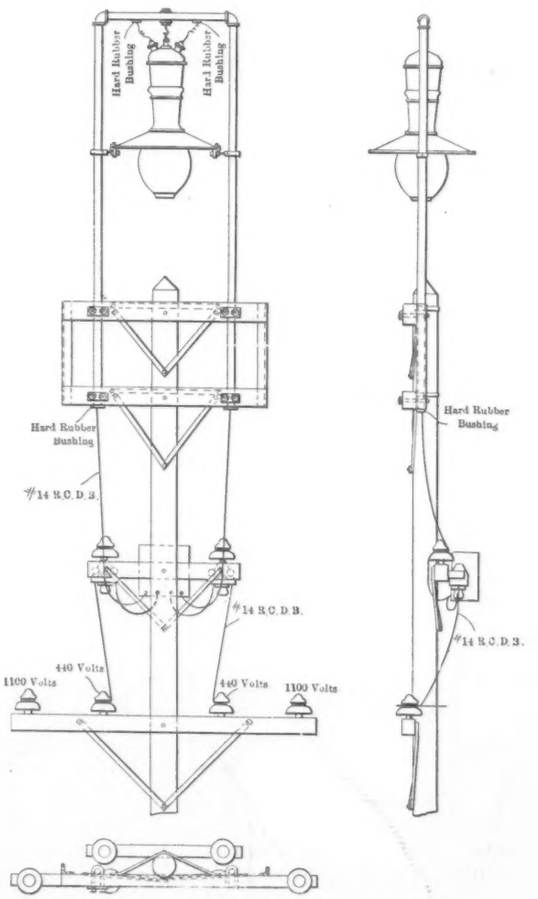


Fig. 3—Flaming-Arc Post Details.

between the lamps increasing through the classification yard and out into the forwarding and receiving yards, where some of the lamps are spaced 600 ft. A spacing of 400 ft. was found to give a very satisfactory illumination for general work with the lamps located 40 ft. above the rails, making it possible for men standing on the cars to see underneath the lamps.

The problem of locating the different lamps was worked out in conference with the railway engineers, and when the system was put in service it was found necessary to move but one of the lamps—this not to change the distribution of light, but owing to one of the poles obstructing the view of the tower men. This being the first large installation of flaming-arc lamps in a railroad yard in this country, no data were available that could be used as a guide in locating the different lamps. The entire installation, including distribution and erection of poles, feeders, etc., was made without interfering with the operation of the yard and without anyone being injured.

The different types of lamp suspension were considered, with the result that the lamps were installed in pole tops, designed for the installation as shown in Fig. 3.

The arrangement of circuits is such that two ways are provided for supplying energy to the lamps on the humps and in the classification yards. No duplication was attempted for the other yards, where cars could be moved without artificial illumination, if necessary.

The intensity of illumination secured equaled all expectations, and when the lamps were started up in the north half of the yard the effect produced was such that engineers on trains crossing the Eads and Merchants' bridges, twelve miles away, could plainly see the illumination, and residents as far distant as ten miles telephoned to ask what was burning at Dupo. Since the system has been put in operation it has been possible to secure results in operating and policing the yard at night such as have never been approached elsewhere. Fig. 1, from a photograph taken at night, gives an indication of the intensity of illumination secured.

At the present time this yard is without question the best artificially illuminated railway freight yard in the country and the only one in which the results obtained give anything approaching a uniform intensity of illumination over the entire area. We are indebted to Westinghouse, Church, Kerr & Company for blue prints and photograph from which the accompanying illustrations were engraved.

Letters to the Editor.

The Comparison of Illuminants.

To the Editor of Electrical World:

Sir:—The letter by Mr. Sydney W. Ashe in your first issue for March calls attention to certain facts to which entirely too little attention is paid. The term "candle-power" when applied to any source of light departing to any appreciable extent from a point is liable to lead to misrepresentation and is almost sure to result in confusion. Although when the source is considerably extended it may still be treated as a point source if it does in fact consist of a large number of widely separated points, yet, when it is a surface source, and especially when the real source is a lamp with a parabolic or concentrating reflector, the term "candle-power" as usually applied is meaningless, its use being permissible only when accompanied by the explanatory words "apparent at a distance of ———," either directly stated or strongly implied.

The only logical method of rating a lamp's output is in "lumens," 4π (approximately 12.5) of which equal 1 mean spherical candle-power. The only logical method of expressing the illumination is in lumens per unit area—1 lumen per square foot being 1 ft.-candle, 1 lumen per square meter being 1 meter-candle. When light output is expressed in flux (lumens) and illumination is expressed in flux density, all of the calculations are greatly simplified as compared with calculations required when dealing with candle-power, inverse square of distance from source, cosine of angle of incidence, etc., most of which can often be eliminated in "wholesale" estimations.

New York, N. Y. R. Hillberg.

Canadian Electrical Association.

To the Editor of Electrical World:

Sir:—I note that in your report of the minutes of the National Electric Light Association it was stated that the Canadian Electrical Association had unanimously voted for affiliation with the National Electric Light Association. I wish you would be kind enough to state in reference to this matter that a special meeting of the members of the Canadian Association was called on Jan. 20, 1911, at Toronto, for the purpose of voting on the question of affiliation. Out of 474 members in the Canadian Electrical Association, and out of some 200 voting members, only eleven voting members were present at this special meeting, these eleven voting unanimously for affiliation. The secretary reported at this meeting that he had received a number of letters from members of the association, and a large number of the letters were written in opposition to the idea of affiliation. It will, therefore, readily be seen that affiliation was not voted upon by the members of the Canadian Association unanimously by any means, and it would only be right that this matter should be fairly understood by your readers.

P. S. Coate,

Late President Canadian Electrical Association.

Chatham, Ont.

Digest of Current Electrical Literature

ABSTRACT OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Angular Displacement in Synchronous Machines.—W. W. Firth.—An illustrated paper read before the Newcastle Section of the (British) Institution of Electrical Engineers. When the working conditions of a generator and synchronous-motor system are changed by alteration of the load or the excitation of either machine, a relative mechanical displacement of the rotors takes place, and if the change is sufficiently rapid there is an oscillation or phase swing about the new position of equilibrium which is quickly damped out by eddy currents and friction. The magnitude of the steady displacement is governed by the condition that the vector sum of the circuit voltages must be zero; or, in other words, that the resultant of the generated voltages of generator and motor is equal to the impedance drop in the circuit. These voltages depend upon the exciting currents of the machine together with their armature reactions, while the impedance drop is proportional to the current in the line. The author discusses in detail the influence of the armature m.m.f. in modifying the effective strength of the magnetic field. Some tests were made by the author with two similar 5-kw, four-pole separately excited converters with connections for both single-phase and three-phase working. The generator was driven by a directly coupled direct-current motor, and the second machine when running as a synchronous motor was loaded by a direct-current directly coupled generator and when running as a converter by rheostats. The four machines are in line with the synchronous machines in the center. Fig. 1 shows the apparatus used for observing or recording the space-phase displacement. Fixed on the half coupling on the motor shaft is a sheet-iron ring R carrying a pinhole H. On the end of the shaft of the generator is fixed a small mirror M with the reflecting surface in the axes of rotation; S is a fixed shield with another pinhole on it opposite to that in the ring. The light from an arc A passes through the two holes in line once per revolution of the motor and strikes the mirror M if the latter is suitably adjusted with reference to the synchronous position of running. Then it passes through the fixed lens L to the tracing-screen T or alternately to the drum D, which carries the recording sensitive paper. When relative motion of the armatures takes place its amount is measured by the change of position of the spot of light on the screen or drum. The spot of light is intermittent, and when a space-phase swing occurs gives rise to a series of dots on the sensitive paper. The apparatus was calibrated with the machines standing and the pinholes in line. It was found that equal angles of turning of the generator armature gave equal space-phase displacements on the

screen of the spot of light, the errors of refraction of the lens almost exactly compensating for lack of curvature of the screen. Observations of the steady displacement with change of load and with change of excitation were plotted. The displacements at two constant speeds show that the displacement decreases with increase of speed for any given load; that it is much less

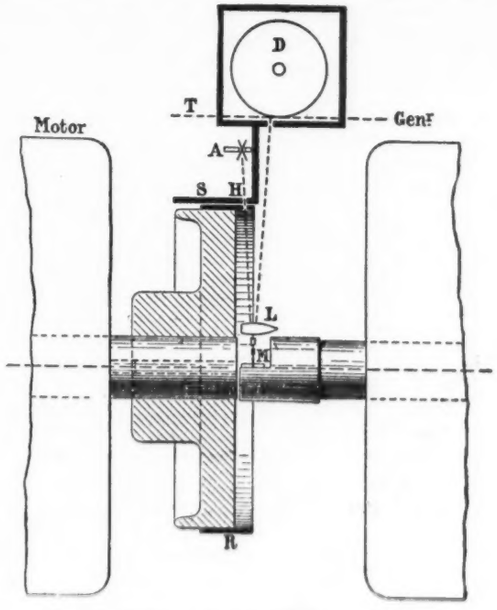


Fig. 1—Diagram of Testing Apparatus Used.

in three-phase than single-phase machines and less again for converters than for synchronous motors. The latter might be predicted from the fact that in converters the armature reaction is much smaller than in synchronous motors.—Lond. *Electrician*, March 17.

Commutator Truing Machines.—A description of an apparatus of O. Kirchenberger which enables anyone to true up a commutator on the spot accurately and promptly without dismounting the machine. The commutators or slip-rings are turned in the bearings of the machine so as to be perfectly true. After removing a brush-holder carrier with its insulation, the arm *A* (Fig. 2) is fixed in its place by means of a screw *S* as firmly as possible. The support *B*, which is free to slide in the top part of arm *A*, is then adjusted to reach over the width of the commutator that requires turning down, after which the steel cutter is set in position, while the screw *S* and the bolt *K*

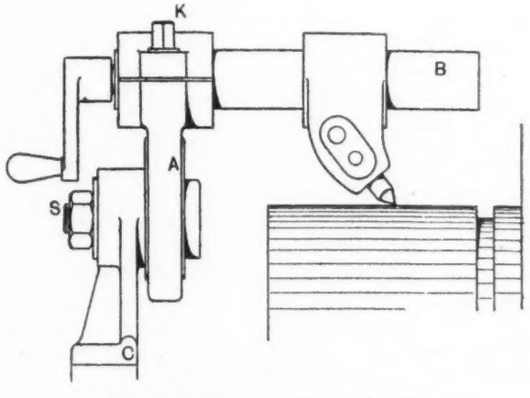


Fig. 2—Commutator Truing Device.

are tightened up, and the brush-holder ring *C* is secured by tightening its set screw (generally fitted with a handle) so that it will not turn round. In the meantime the position of the cutter is slightly altered, coming into place of its own accord, so that even unskilled persons can do the work. The cutting speed varies between 8 m and 10 m per minute. Where there is no motor for driving the armature a crank is attached to the end of the shaft, the armature being turned round by hand. The steel cutter is made of first-class high-speed steel.—Lond. *Elec. Review*, March 10.

Lamps and Lighting.

Water Sterilization by Ultra-Violet Rays.—An account of experiments made in Paris by Henri, Helbronner and von Recklinghausen on the use of the ultra-violet rays from a mercury-vapor lamp for the sterilization of drinking water. Two different apparatus have been devised. The first apparatus is illustrated in Fig. 3. It was designed to give a large output of water, as much as 125 cu. m per hour, or sufficient for a town of about 20,000 inhabitants. The dimensions of the apparatus were fixed upon after the following experimental data had been

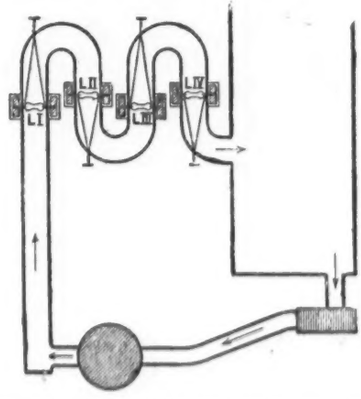


Fig. 3—Early Type of Water-Sterilization Apparatus.

obtained. The rays given off by the quartz mercury-vapor lamp (Westinghouse-Cooper Hewitt type) working at 220 volts with a current of 3 amp will completely destroy the microbes contained in water, including bacillus coli and other very dangerous microbes (cholera, dysentery, etc.), at the following distances and in the following times: At 60 cm, 40 cm, 20 cm and 10 cm from the lamp the times are respectively thirty seconds, fifteen seconds, four seconds and less than one second. The lamp should, therefore, be placed as near as possible to the surface of the water and a sufficiently slow flow used, so as to give the rays the proper time to act. It is best to use several lamps in this case, and to dispose of the apparatus so that the surface water coming under the first lamp is brought to the bottom, thus providing a fresh surface under the second lamp, and so on, thereby constantly changing the position of the water. An apparatus of this type, recently exhibited at Marseilles, is composed of a water tank of 3 cu. m capacity, a turbine pump, a water meter and the sterilizer proper formed of the triple-curved conduit 25 cm wide and 50 cm deep. Four mercury-vapor lamps, *LI*, etc., are placed in the positions indicated, and are suspended from the floats which keep them at a constant distance above the water, this distance being 2 cm. Above each lamp is placed a reflector of suitable type. With this apparatus the water is found to be completely sterilized when it has passed the second lamp. Such water was charged very heavily with bacteria when in the tank by appropriate means. Starting with 5250 microbes per cubic centimeter, 3650 were found after the first lamp had been passed and none after the second lamp. Each lamp takes 660 watts, and thus in the present test 36 cu. m of water is sterilized with 1320 watt-hours, use being made of only two of the lamps. For a higher rate of flow it would be necessary to use three or four lamps, according to circumstances. The above figures correspond to 36 watt-hours per cubic meter, but this figure has been reduced. In the second and more recent apparatus the lamp is immersed in the water, but direct contact of the globe with the water would be detrimental, as it would reduce the temperature of the lamp. The lamp is, therefore, inclosed in a protecting box with the three principal sides made of quartz plates. The arrangement is shown in Fig. 4. (See *Electrical World*, Dec. 1, 1910.) An electrically operated valve insures that no water can

be passed through the sterilizing chamber should the lamp break or the current supply be cut off. In series with the lamp is an electromagnet *M* which holds the valve up against its seat, so that in normal working no water passes through the valve. Should the circuit be broken, the valve is dropped and all the water then flows out at *V* without entering the steriliza-

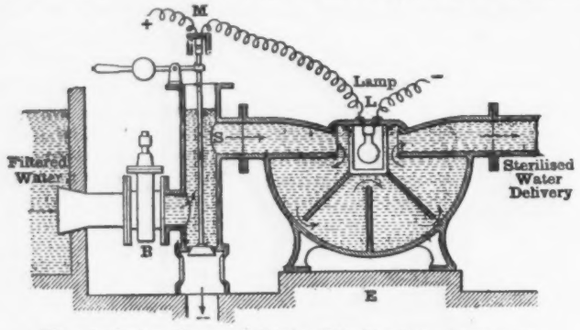


Fig. 4—Later Type of Water-Sterilization Apparatus.

tion chamber. In this way no unsterilized water can be delivered by the apparatus. Previously filtered water must be used. —Lond. *Electrician*, March 17.

Generation, Transmission and Distribution.

Condensing Plants.—G. L. Kothny.—An abstract of a paper read before the (British) Junior Institution of Engineers. The author spoke chiefly about modern air pumps, realizing that with the high vacua now demanded this part of the plant is of supreme importance. Dealing mainly with rotary pumps, he described in detail the Le Blanc dry-air pump. It was shown that a reversed turbine wheel, revolving before a jet of water, cuts off thin sheets, each of which, projected through stationary nozzles, entraps a layer of air. This air and water sandwich is compressed into a plug which passes through a diffuser to the atmosphere or at any required head. The author explained that the latest design can be self-starting, and will continue working with unexpectedly heavy air leaks. He next outlined various forms of condensers to which the rotary principle is applied, dealing first with the "simple jet," in which the steam is condensed and the air removed by a single jet composed of many sheets of water, exposing an enormous surface to the steam. He next described the "multiple jet," in which the cooling water is projected through nozzles into a steam space and is thence extracted by a turbine pump mounted on the air-pump shaft, the latter working on the above-mentioned system. After touching briefly on "barometric plants," the author passed on to the consideration of "surface condensers" and gave a description of turbo-driven auxiliaries, air-circulating and hot-well pumps, all being directly coupled to a small impulse turbine. In conclusion he discussed the relative advantages of the different types and the particular purposes to which they are adaptable, other than standard work, such as soap making, sugar refining, refrigerating, etc., and expressed his opinion that rotary auxiliaries will as rapidly supplant reciprocating sets as the turbine is doing in main units. Tables were shown which clearly indicated that the rotary air pump can compete favorably with the most modern reciprocating types and give better results in the higher range of vacua, combined with maximum simplicity, there being only one rotary wheel, while all valves are eliminated.—Lond. *Electrician*, March 17.

Boilers.—In the course of an informal discussion on boilers at Sheffield two new types were described. One of these, made by Hawksley, Wild & Company, is a water-tube boiler with nearly vertical tubes and embodying a new design of tube plate; the other, made by Frazer & Chalmers, under the Bettington patents, is fired with coal dust. Some details are given on the construction of both types.—Lond. *Elec. Eng'ing*, March 16.

Traction.

Electric Locomotives.—A note on tests now being carried out between Cannes and Grasse with an electric locomotive built by the Alioth Company according to the system devised by Auvert and Ferrand. This locomotive is supplied with single-phase current at 12,000 volts and a frequency of 25, and has been drawing trains weighing (without the locomotive) 220 tons on the Mediterranean coast line at a speed of thirty-five miles per hour on 2 per cent gradients. The 12,000-volt current is supplied from an overhead wire, is reduced in e.m.f. for the locomotive by transformers and converted to direct current by two special mechanical rectifiers. The power demand from the network at starting is insignificant. For instance, a very heavy train takes only 150 kw, a figure which rises to 1000 kw or even 1500 kw as the speed increases. This is due to the fact that Auvert and Ferrand regulate their locomotive by altering the position of the brushes on the rectifier. At starting the voltage is practically nothing, being just sufficient to maintain in the series motors a current corresponding to the torque to be overcome. At full speed the total voltage is utilized, the brushes having been moved progressively. The arrangement allows the torque to be regulated at will. Another advantage of the system is that the power-factor is never less than 0.5 even at starting, while at full load it varies between 0.95 and 0.98. The total efficiency is very high, as the ratio of the mechanical power at the road wheels to the high-tension power at the station is about 0.78. This locomotive, it is claimed, possesses all the advantages of both single-phase and direct-current locomotives, with none of their disadvantages. Tests which have just been made show that the power that can be exerted easily exceeds that of the best steam locomotives.—Lond. *Electrician*, March 17.

Mechanical Feature of Electric Locomotives.—B. P. Haigh.—An abstract of a paper read before the (British) Institution of Engineers and Shipbuilders in Scotland. The author pointed out that several mechanical problems have arisen in the design of large electric locomotives, one of these being the collection of the heavy current required from the overhead conductor or third rail. From the point of view of the mechanical engineer the "single-phase" system is much more promising for high speeds than either the direct-current or three-phase system, as only a single overhead conductor and collector are required. The main problems as compared with modern steam practice arise from the fact that electric locomotives are much lighter than the steam equipment of equal power. For this reason it is necessary to put a greater proportion of the total weight when possible on the driving wheels. Against this is the known fact that a leading bogie gives smoother running. In the largest locomotives driving bogies have been less successful than in moderate sizes, for the great height of the bogies necessitated by the large motors and driving wheels causes great strains in the upper framing. Articulated locomotives and others with semi-rigid wheel-bases have been more successful. Perhaps the most important point requiring attention is the support of the motors so as to avoid excessive vibration and shock on the rails. It is immaterial how the weight of the motors is transmitted to the driving wheels so long as the great mass of the motors is not forced to vibrate along with the axles. In the largest locomotives this problem has been solved by supporting the motors, weighing up to 15 tons each, on the main framing, the motion being transmitted to the driving wheels by means of connecting rods.—Lond. *Electrician*, March 17.

Thermit Welding.—Brewitt.—An illustrated account of a lecture on the different applications of thermit welding for the repairs of broken castings, etc., with special reference to the welding of rails.—*Elek. Zeit.*, March 16.

Installations, Systems and Appliances.

Breaking High-Potential and Low-Potential Circuits.—A. G. Collis.—The conclusion of his paper. In the present instalment the author deals with alternating-current tests. So far as his tests were carried they confirm the practice of the industry in the general use of oil switches for alternating-current work as being a wise practice. A large volume of oil adds considerably to the factor of safety, and the oil should, of course, have a high flash point. Some notes are also given of the resistances between carbon contacts in comparison with other contacts and it is shown that the carbon contact is relatively of very low conductivity. With moderate currents this is not of serious consequence, but with heavy currents, such as are experienced in

cases of short-circuits, some burning of the main brush is difficult to avoid. On that account the practice of using metallic contacts for the auxiliary breaks is to be recommended as a general rule. An account of the extended discussion which followed is also given.—Lond. *Electrician,* March 17.

Meter Testing in Central Stations.—A. T. Bullen.—The author gives practical rules on arrangements of meter tests in central stations which he thinks are very important. The introduction of low candle-power metallic-filament lamps has become a source of great loss to many supply companies, but a large proportion of this loss occurs through the older types of meters being called upon to register small amounts which they are not sensitive enough to record. He prefers to use in the testroom a set of standard meters which would be checked by the instruments every morning; the actual calibration of the meters would then be carried out by running them with the standard meters.—Lond. *Elec. Review,* March 10.

Conveying Systems in Post Offices.—E. W. Pettit.—An abstract of a paper read before the (British) Institution of Post Office Electrical Engineers. The author emphasized the difficulty of commercially justifying the introduction of conveyors into existing post offices because, on account of the complex organization of these offices, it is only possible in the majority of cases to deal mechanically with sections of the work and not with the whole of it. Yet considerations of speed, increased facilities for supervision and general convenience may, and often do, make the installation of conveying machinery desirable. The principal conditions to be fulfilled by postal conveyors are freedom from breakdown and danger to staff and the elimination of the machinery from the office itself. In the opinion of the author the conveyor which more closely approximates to these conditions than any of its rivals is the form known as the "band," and he showed complete designs for two large conveyors, one 450 ft. in length and suitable for carrying bags weighing up to 125 lb. or 57 kg. Methods of distributing correspondence from band conveyors, either at stated positions or automatically over a given length by means of deflection plates, were discussed. It is stated that the authorities of the British Post Office have been making experiments on conveying systems for some time past and that conveyors will probably be installed in the near future.—Lond. *Electrician,* March 17.

Automatic Control of Motors.—Henry.—An illustrated article on arrangements of controllers for the automatic control of motors, especially rolling-mill motors.—*L'Industrie Elec.,* March 10.

Wires, Wiring and Conduits.

Improvements in Underground Conduit Construction.—E. N. Lake.—An illustrated paper read before the Western Society of Engineers. The author first discusses the use of vitrified clay and the arrangement of the ducts, and then passes on to consider the connections between underground mains and the overhead line of an electric tramway. He finally suggests improvements in manhole fittings.—Lond. *Electrician,* March 17.

Electrophysics and Magnetism.

Principles of Thermodynamics.—H. L. Callendar.—His presidential address to the British Physical Society in which the author shows that the caloric theory of heat as developed by Carnot in his "Reflections on the Motive Power of Heat" (Paris, 1824) leads immediately to the correct solution of the relations between heat and motive power (energy or work) in all reversible processes, and appears to be in some respects preferable to the mechanical theory as a method of expression because it emphasizes more clearly the distinction, first clearly stated by Carnot, between reversible and irreversible transformations, and because it directly provides the natural measure of a quantity of heat as distinct from a quantity of thermal energy. The caloric theory is perfectly consistent with Carnot's principle and with the mechanical theory for all reversible processes. Caloric is the natural measure of a quantity of heat in accordance with Carnot's equation, if the gas-scale of temperature be adopted. The only defect of the caloric theory lay in the tacit assumption, so easily rectified, that the ordinary calorimetric units are units of caloric. The quantity measured in an ordinary calorimetric experiment is the motive power or energy of the caloric, and not the caloric itself. If this had been realized in 1850 it would have been quite unnecessary to recast and revolutionize the entire theory of heat.—Lond. *Electrician,* March 10.

Röntgen Rays.—R. Whiddington.—A note on a paper read before the Royal Society of London on the production and properties of soft Röntgen radiation. Röntgen rays from ordinary bulbs are usually produced at generating potentials of between 10,000 volts and 100,000 volts. It is possible by using a special tube with a very thin aluminum window to experiment with rays generated at only a few hundred volts. The rays dealt with in this paper were generated at from 1000 volts to 3500 volts. It has been found that such soft Röntgen rays have much the same properties as the harder rays usually experimented with. They produce ionization in air, affect photographic plates and can excite secondary radiations when incident on solid bodies. Their range in air, however, is not many centimeters. For many purposes a Röntgen radiation is sufficiently defined by a knowledge of the total energy and the penetrating powers in absorbing screens. These two properties were, therefore, investigated in some detail, with reference particularly to the influence exerted by the material of the anti-cathode and the potential at which the rays are generated. The anti-cathodes used fall naturally into two groupings: Group A—Al, Pt. Group B—Ag, Cd, Cu, Fe, Ni, Pb, Sb, Sn, Zn. The anti-cathodes of Group A emit secondary radiations, those of Group B do not.—Lond. *Electrician,* March 10.

Units, Measurements and Instruments.

High-Voltage Storage Battery.—A. A. Campbell Swinton.—An illustrated paper read before the Röntgen Society on a storage battery of the Planté type for high-tension direct-current experiments. The battery consists of 4800 cells. The reason for this particular number is that it divides up into convenient sections of eighty cells for the purpose of charging in parallel off the 200-volt supply. When all the cells are in series the battery gives 10,400 volts on open circuit. The 4800 cells are contained in five cabinets, which hold 960 cells each. They are arranged in twenty-four blocks of forty cells each. Each cell consists of a glass test tube 4 in. long and of 0.75-in. bore, and each set of forty cells is cast solid with paraffin wax in a wooden tray. With the full 10,000 volts between polished brass balls, 12.5 mm in diameter, the current is found to jump some 2.5 mm, and the resultant arc can be drawn out into a considerable length, largely dependent on the amount of resistance in the circuit and consequent strength of the current. That the current is often not entirely continuous is evidenced by the fact that the arc makes a whistling sound of very high periodicity. Connecting a Leyden jar across the arc immediately converts it into a series of sparks, which give out a musical note.—Lond. *Electrician,* March 10.

Frequency Meter.—A note on a recent British patent (16,342, March 9, 1911) of the Siemens & Halske Company for an instrument for indicating and recording frequency, which consists of a voltmeter arrangement in parallel with an inductance with a condenser in series with both. The closed iron circuit of the inductance is saturated so that the resonance point of the measuring circuit is displaced with any alteration of current and the circuit is tuned so that the whole range of the instrument lies outside the resonance point. The use of a highly saturated transformer core with large leakage, and also of a second voltmeter in opposition, to eliminate the effect of variations in the pressure, is also covered by this patent.—Lond. *Elec. Eng'ing,* March 16.

Motor Meter.—An illustrated announcement by the Reichsanstalt admitting a direct-current motor meter of the Isaria Company for official calibration. The construction of the meter, which is built for currents of from 3 amp to 30 amp and voltages up to 600 for two-wire and three-wire direct-current installations, is described and illustrated.—*Elek Zeit.,* March 9.

Telegraphy, Telephony and Signals.

Protection of Telephone Lines.—An illustrated description of methods for the protection of telephone lines against atmos-

pheric electricity and transmission circuits. The article is illustrated by numerous diagrams.—*Elek. Anz.*, March 5 and 9.

Electricity Transmission in Cables.—K. W. Wagner.—A paper on the mathematical theory of the propagation of electricity in cables if there is an energy loss in the dielectric. The author also discusses briefly the possibilities of transatlantic cable telephony, but finds that the prospects so far are poor.—*Elek. Zeit.*, March 16.

Spectrum of the Poulsen Arc.—E. O'Connor.—An account of an investigation of the spectrum of the Poulsen arc when there are strong oscillations in the oscillation circuit and when there are not, with a discussion of the mechanism of the production of the oscillations.—*Phys. Zeit.*, March 15.

Miscellaneous.

Definitions.—A set of seventy-seven definitions of important terms used in electrical engineering with comments on the different definitions. "Anker" (armature) is defined, for instance, as that part of the machines in which the lines of the magnetic flux are in motion relatively to the metal when the machine is in operation.—*Elek. Zeit.*, March 2.

Heating Apparatus.—A note on a recent British patent (26,120, March 9, 1911) of the British Thomson-Houston Company (General Electric Company of this country). A flat heating unit for hot plates and other electric heating apparatus is constructed by covering a length of the insulated resistor with a metal tape or a thin metal sheath deposited on the insulation. The conductor is then wound into a close helix and electroplated until the whole becomes as rigid as a solid disk of metal. This results in a heating unit in which the conductor is in close contact with the metal to be heated and is well protected.—Lond. *Elec. Eng'ing*, March 16.

Plastic Insulating Materials.—A. Hakannson.—A translation in abstract of his recent German paper. The author discusses the properties of plastic insulating materials now largely used in electrical manufacture. They may be classed as (1) rubber substitutes, (2) insulators with organic binding materials, (3) insulators with inorganic materials. Mechanical strength, hygroscopic and heat-resisting properties are considered, and emphasis is laid on the fact that insulation resistance often falls off enormously as the temperature is raised.—Lond. *Electrician*, March 10.

"Commercial Engineering."—M. J. Railing.—An address delivered before the Municipal School of Birmingham. The author urges that our technical education should proceed on broad lines and should not overlook the fact that subjects which are not strictly technical are nevertheless a part of the necessary equipment of the successful engineer. It is only by such a combination of strictly technical and commercial knowledge that a supply can be obtained of trained engineers able to regain for Great Britain the premier position among manufacturing countries of the world.—Lond. *Electrician*, March 10.

Architects and Electrical Engineers.—K. Simons.—The author discusses the possibilities of giving to architects the proper and desirable training in electrical engineering in German institutes of technology.—*Elek. Zeit.*, March 16.

Book Reviews.

Electric Motors. By Francis B. Crocker and Morton Arendt. New York: D. Van Nostrand Company. 291 pages, 158 illus. Price, $2.50.

Professors Crocker and Arendt have arranged in book form the substance of a course of lectures on electric motors and their applications given in Columbia University. The subject matter has been selected with great care and is presented in excellent style.

The types of motors dealt with include the various forms of direct-current motors, single-phase and polyphase induction motors, synchronous motors and commutating alternating-current motors. Each of these types is discussed with reference to its operating characteristics and applicability for certain services. No mention is made of methods of design or of design constants. However, design proportions are not entirely ignored in that they are indirectly considered in connection with the discussion of the characteristics of motors suitable for various applications.

Somewhat less than one-half of the book is devoted to direct-current motors, much attention being given to adjustable-speed machines of both the variable-reluctance and the variable field-current types. As introductory to the section relating to alternating-current motors a chapter is added on the history of the development of the various types now in use. It is interesting to note that most credit is given to Professor Ferraris for the invention of the induction motor and to Professors Anthony, Jackson and Ryan for the invention of the machine commonly known as the repulsion motor. Both of these machines seem to have been patented in 1888, the former having been invented in 1885 and the latter in 1887.

The authors have employed remarkably simple methods for representing the characteristics of synchronous and asynchronous motors and have succeeded in explaining all of the essential features without resort to complicated mathematical analysis. Simplicity in presentation also characterizes the chapter on commutating alternating-current motors, which, however, appears too brief in view of the increasing industrial importance of these motors and the desirability of greater knowledge of their main features on the part of students now graduating from electrical engineering courses.

The book as a whole is well balanced and is conveniently arranged for instructional purposes.

Application of Arc Lamps to Practical Purposes. By Justus Eck. London: S. Rentill & Company. 101 pages, 90 ills. Price, 2s. 6d.

The task to which this author has applied himself is the very practical one of selecting those units from the number of existing types of modern English arc lamps which are best adapted for lighting certain kinds of interiors. Beginning with the flux-distribution curves of various direct and indirect arc lamps, it is shown how these can be applied to illuminate such interiors as art galleries, show windows, halls, shops, factories, etc. Detailed descriptions are also given of the modern types of alternating-current and direct-current inclosed, flaming and metallic-flame arc lamps in use in Great Britain. Several pages are included on arc-lamp auxiliary and switchboard apparatus and on arc-lamp testing.

Scientific Management and Railroads. By Louis D. Brandeis. New York: The *Engineering Magazine*. 92 pages. Price, $1.

The statement by Mr. Louis D. Brandeis that "at least $1,000,000 a day" could be saved to the railroads of the country by scientific management created more than a passing sensation when made some months ago. The evidence upon which this statement was made was submitted to the Interstate Commerce Commission in the form of a brief by Mr. Brandeis on Jan. 3, 1911. The present book contains the essential parts of that brief arranged in logical order to bring out the main conclusion, which is that if the net income of the railroads is insufficient the proper remedy is not higher rates, resulting in higher costs and lessened business, but scientific management, resulting in lower costs, in higher wages and increased business. A record is given of the testimony offered as to the profitable results from the use of methods that have proved effective and economical in manufacturing establishments.

Electrical Pocket Book for 1911. Manchester: Emmott & Company. 208 pages. Price, 6d.

The 1911 number of this reference book is marked by condensation of the material in preceding issues, affording room for a number of new tables. These include data on current density, temperature rise, losses, illumination, life of lamps, depreciation, etc. Most of the material printed in this volume

can be used to advantage by the practical installer, but aside from the reference tables the text matter is chiefly of an elementary character.

Several pages which are devoted to the subject of "cheap house wiring" describe systems of surface-molding work that have been brought out abroad and are taken advantage of to cheapen construction commensurate with the economy of service made possible by the tungsten lamp. Obviously these forms of construction hardly satisfy American standards of wiring construction.

New Apparatus and Appliances

ALTERNATING-CURRENT CONTROLLING APPARATUS.

Of the accompanying illustrations, Fig. 1 shows an alternating-current single-phase motor starter of the hand-release type and Fig. 2 an alternating-current single-phase speed regulator without the automatic release. The construction of these appliances, which are made by the Independent Electric Manufacturing Company, of Milwaukee, Wis., is marked by simplicity and rigidity throughout, and is the result of much experimental work. The resistor element of the starter is inclosed in a fireproof and moisture-proof cast-iron box, careful provision being made for ventilation. The corresponding element of the speed regulator is contained in a semi-inclosed cast-iron box. One good feature about these motor-controlling appliances is the large wearing surface, together with ample carrying capacity proportioned to all parts.

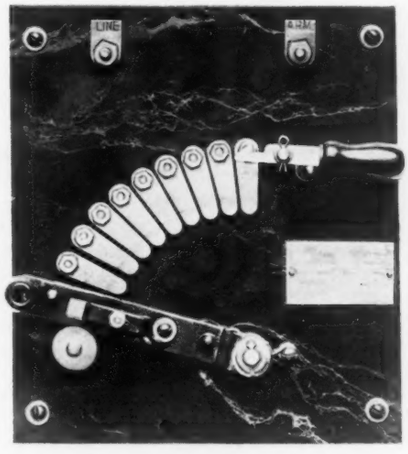


Fig. 1—Alternating-Current Single-Phase Starter with Hand Release.

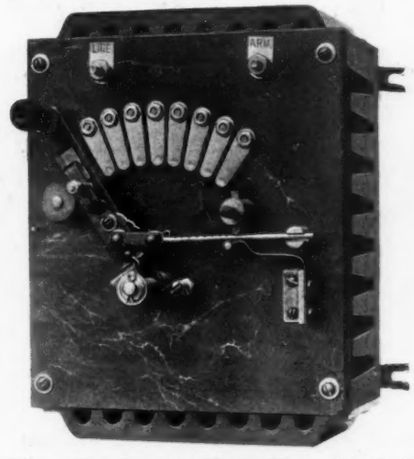


Fig. 2—Alternating-Current Single-Phase Speed Controller.

IRONCLAD FUSED SWITCH.

The Detroit Fuse & Manufacturing Company, Detroit, Mich., has placed on the market a new type of switch known as the "severe-service junction-box switch." In addition to being an ironclad fused switch, this device provides for the branching out of circuits in all directions and for the main lines passing entirely through the box and under the porcelain base. The switch is of the quick make-and-break type, positive in its action, and controlled instantly from the outside of a cast-iron box. All working parts are of phosphor bronze, making a rustproof design, and the switch is equipped with gaskets, giving a water-tight construction. It can be installed outdoors or where directly exposed to water, steam, fumes or any other extreme condition. This switch is especially desirable for engine-house service and is being rapidly adopted, it is claimed, by prominent railroads as part of their equipment.

Junction-Box Switch.

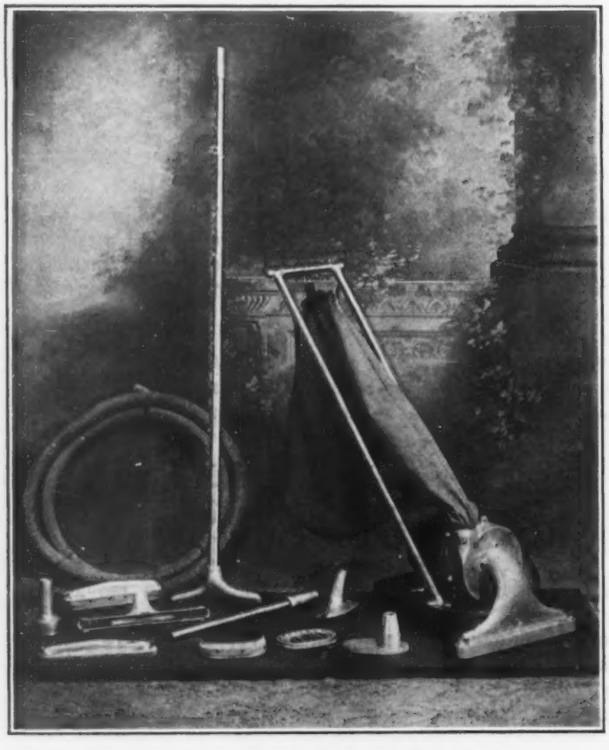
AN ELECTRICAL RECORDING COMPASS.

The principle of the curve-drawing meter has been applied advantageously to the mariner's compass, thereby providing a continuous record of the direction in which the ship was heading during any hour and minute of her voyage. The instrument shows variations of direction within 2.5 deg., or half a point, and also furnishes a log of sea conditions, presenting an irregular line under choppy weather and a smooth curve in smooth water. The curve-drawing apparatus is separate from the contact-making compass and binnacle, but is connected to it through a pair of wires. Standard ship's lighting e.m.f., 100 volts to 125 volts, can be used for operating the compass. In case of interruption to the generator voltage an automatic circuit-breaker throws the compass mechanism onto batteries, thereby restoring it to the generators again when service is resumed. The chart is fed under the recording pen at the rate of 2.5 in. per hour by an electrically wound clock movement.

One chart lasts thirty-one days, and is graduated to five-minute spaces so that one-minute intervals can be read easily. The binnacle for the recording compass is provided with compensating devices for making all corrections for magnetic deviations. These curve-drawing compasses, which are manufactured by the Schuette Recording Compass Company, of Manitowoc, Wis., have been in daily use on navigable waters for three years, under all kinds of weather, and are reported to have given excellent results.

PORTABLE VACUUM CLEANER.

The vacuum cleaner built by the Semco Vacuum Cleaner Company, Nashville, Tenn., is equipped with a ⅛-hp motor and weighs complete 33 lb. The machine is also adapted to be used for blowing purposes, exhausting foul air, hair drying, grinding and sharpening cutlery, polishing silverware, drilling, running a sewing machine, etc. The motor bearings are equipped with large oil cups and the motor has a ½-in. shaft. Alternating-current and direct-current motors of standard voltages are used in connection with a rotary suction fan placed directly on the motor shaft. The fan is of boxed construction and thrown off center, which is claimed to add to the efficacy of its work. The dust bag is of ample proportions for the service required. When it is desired to use the motor for running a sewing machine the former is pushed up beside the sewing machine and a belt placed on a deep-groove pulley on the motor shaft, the other end of which holds the suction fan. The speed regulation of the sewing machine is governed by an idler arrangement attached to the pedal of the machine and controlled by the foot of the operator. For polishing brass the shaft is extended ½ in. beyond the grooved pulley and on this shaft is a screw



Portable Vacuum Cleaner and Cleaning Tools.

tapering chuck for holding the cloth-buffing wheel, also a bristle brush. For grinding and sharpening, a plain chuck is used with an emery wheel. For hair-drying purposes tools are used on the blowing end of the fan. The vacuum cleaner itself can be used by pushing it along the floor or by attaching a hose to the machine. The usual cleaning tools form part of the equipment. No revolving brush is employed, but a stationary brush is confined in the tool used on the cleaner when it is pushed along the floor. This tool covers 14 in. of floor space. The manufacturer points to the numerous applications which can be obtained without making any changes in the machine.

A NEW SUCTION CLEANER.

The suction cleaner illustrated herewith is built in both the portable and stationary types. In the former the pump is mounted above a small electric motor, to which it is belted.

Fig. 1—Portable Cleaner with Cylindrical Case Removed.

The bag of screening material is placed above the pump, and the whole is placed in a cylindrical case. The air drawn into the machine leaves its dust in the bag, and on its passage out is used to ventilate the motor. If desired the action may be reversed, the machine being used as a blower for hair drying, renovating pillows, blowing out pianos, etc. The motor in the

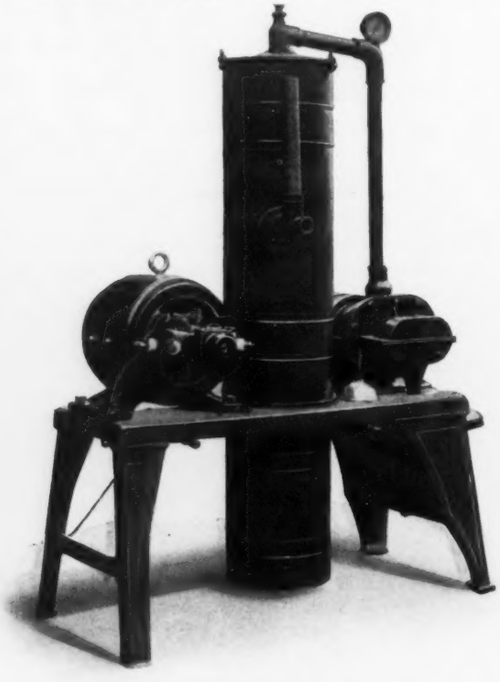


Fig. 2—Stationary Type of Cleaner, Showing Connection for Standpipe.

portable machine is rated at 1/6 hp and the machine complete weighs 50 lb. A number of attachments for vacuum cleaning are provided. In the stationary type the motor and pump are fastened to a bench, the connections to the tank being as shown.

These cleaners are built by the Perfex Cleaner Company, Waukegan, Ill.

VARIABLE-SPEED POLYPHASE MOTOR.

The Richmond Electric Company, Richmond, Va., manufactures a full line of variable-speed polyphase motors ranging in ratings from ¼ hp to 75 hp. The standard form of construction employed is shown in Fig. 1. The motor corresponds very closely in operating characteristics to a shunt-wound direct-current motor with armature control and is suited to work

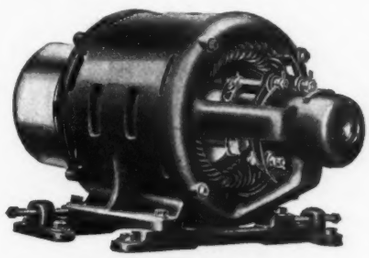


Fig. 1—Polyphase Motor.

requiring a motor of heavy starting torque with minimum starting current. The standard starting rheostats and variable-speed controllers are so designed as to limit the current at starting to one and one-half times normal full-load running current. The motors are well protected and at the same time sufficiently ventilated to permit them to carry heavy loads continuously without abnormal temperature rise. The construction is rugged throughout. The motors can be mounted on the wall or ceiling by turning the end plates 90 deg. to 180 deg. so as to keep the oil wells in a vertical position. A substantial iron subbase is furnished with motors of from ¼-hp to 3-hp rating and rails with motors of from 5-hp to 75-hp rating.

The stator frames are of cast iron in one piece. The section is such that a rigid support is obtained for the laminations. The feet are broad and the entire frame construction is such that there can be no springing. The laminations are of the highest grade electrical sheet steel, and are annealed after the slots are punched in the inner periphery. In this manner the effects of

Fig. 2—Stator of Polyphase Motor.

hardening of the steel, due to punching, are eliminated. The steel is especially treated during the process of annealing to eliminate the effects of aging. Before assembling in the stator frame each disk is japanned and baked. By handling the steel in this manner the hysteresis and eddy losses are reduced to a minimum. The stampings are then clamped in the stator frame under hydraulic pressure between heavy malleable iron rings. At each end of the laminations is a fiber disk with slots of the same size as in the steel punching. These disks are an additional protection to the coils where they come out of the slots. The inside diameters of the stator punchings are ground on a special machine, thereby insuring an accurate air-gap. The partly closed slots are then lined with fiber and mica tubes. The stator windings, which are liberally designed as to carrying capacity, are then placed in position. A hardwood key is driven in, thus closing the top of each slot, and holding the coil secure-

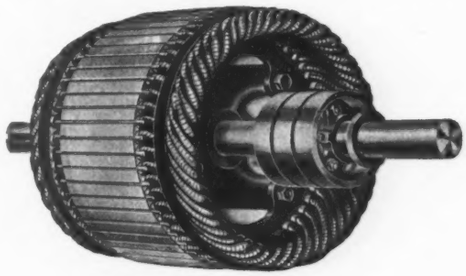


Fig. 3—Rotor of Polyphase Motor.

ly in its place. The coils are carefully taped, and the stator is dipped in a high-grade moisture and oilproof compound and then baked. A 50-hp completed stator ready for assembling is shown in Fig. 2.

The rotors are built and ground in the same manner as the stators. In the smaller sizes the punchings are mounted directly upon the shaft and clamped under hydraulic pressure between malleable iron heads; in the larger sizes the punchings are mounted on spiders and clamped between malleable iron rings. A punching of fiber is placed at each end of the core. The coils are carefully wound on forms and placed in the partly closed slots of the rotor. The rotor is then dipped and baked as in the case of the stator. The rotors are invariably wound for three-phase currents. The collector rings are carefully built and have liberal sections to provide for brush wear.

The bearings are liberal in diameter and length, exceeding, the manufacturer claims, the majority of motors on the market. The linings are one solid casting of phosphor bronze, and rings dipping in large oil chambers provide constant lubrication. A cleaning hole is provided at the bottom of the oil chambers, and an overflow at the side and cover permits ready access for filling and inspection.

In many cases the slow speed of the driven machine requires the use of intermediate gears, and to provide for this condition

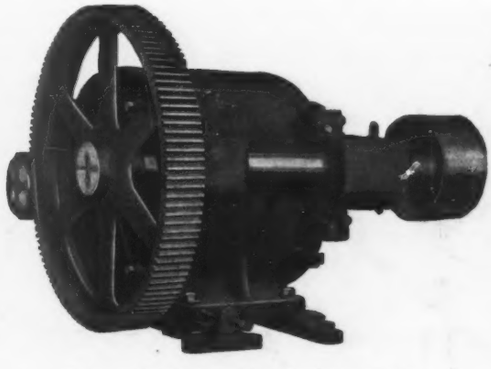


Fig. 4—Back-Geared Polyphase Motor.

motors may be equipped with countershaft, cast-iron cut gear and rawhide pinion, as shown in Fig. 4. The brackets are cast right or left-handed, according to the side of the motor on which the countershaft is to be used. The countershaft bearings on motors larger than 3 hp are supplied with oil rings and oil reservoirs with holes or for draining. Three horsepower motors and smaller have oil-cup lubrication. The standard ratio for back gearing is 5 to 1.

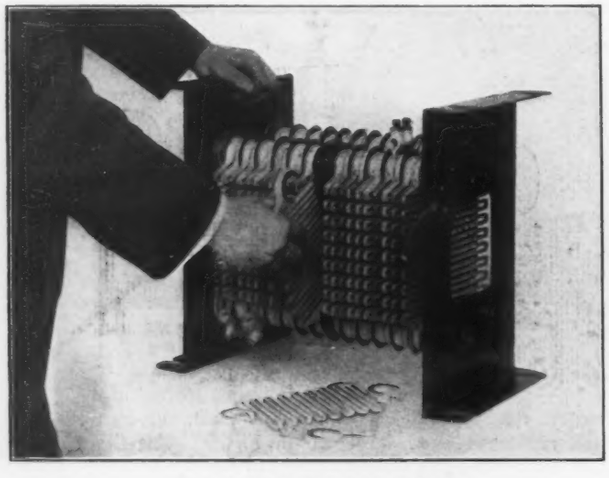
IMMERSION-TYPE ELECTRIC WATER HEATER.

A plunge-type water heater making use of an annular-flue principle for increasing the circulation over its heated surface is shown in the accompanying view. The water-tight barrel containing the heating element is surrounded at a distance of about 3/16 in. by a metal shell, perforated with holes top and bottom, for the admission and egress of the water from the annular flue thus formed about the heating element. This construction is designed to induce a circulation of water past the heating surface, increasing the effectiveness of the device. The resistor element is of alloy wire wound on a lava spool and is inclosed in the water-tight inner barrel. The outer shell also serves as a protection in case the heater is left turned on, out of liquid. The heater is made for use on circuits from 95 volts to 125 volts, and consumes approximately 500 watts at 110 volts. This heater has been developed by the Insto Electric Heater Company, Blymer Building, Cincinnati, Ohio.

Plunge-Type Water Heater.

RHEOSTAT ARRANGED FOR RAPID REPAIRS.

In the rheostat shown herewith the feature of ready repairability has been worked out to the point of maximum convenience. The rheostats are of the cast-iron-grid resistor type.



Rheostat with Removable Grids.

In the ordinary forms the grids are strung on the supporting tie rods like so many beads or buttons on a string, and the replacement of one or more injured grids necessitates the unmounting of the whole rheostat and the removal of practically all the other grids. In the rheostat here shown this trouble is avoided by slotting the supporting bosses at the top and bottom of the grids, thus permitting each grid to be slipped on or off the tie rods without disturbing any of the others. The rheostats are particularly well adapted for railway service. A few extra grids and a wrench carried on the car will eliminate the delays usually encountered during service. Loosening the nuts on the ends of the tie rods, removing the injured grid and slipping in a new one and then retightening the nuts entail a delay of only a few minutes, which is inappreciable on slow urban or interurban schedules and easily made up even under the closest rush-hour headway. This type of rheostat has been developed for the market by the General Electric Company.

TROLLEY-WIRE SPLICER.

A trolley-wire splicer than can be used without bending tools or wrenches is illustrated herewith.

The distinctive feature of the splicer is the method of securing the wire. A tapered and slotted chuck fits snugly around the wire. The chuck is threaded on the inside and when inserted in the tapered hole in the splicer firmly grips the wire.

Trolley-Wire Splicer.

The greater tension there is on the wire the firmer the grip becomes, and it is impossible to pull the wire out of the splicer. The chuck is easily removed, however, when it is desired to take up slack. This splicer has been placed on the market by the Westinghouse Electric & Manufacturing Company.

DIRECT-CURRENT WATT-HOUR METER.

The increasing importance of economy in switchboard space, especially in the larger stations, has created a demand for meters of large rating which can be installed in close proximity to each other. The shunted type of meter is especially suitable for this class of service in that the meter itself can be made of smaller dimensions than is possible with the series type of meter in which all the current to be measured must be passed through the meter itself. With the shunted principle the main series shunt can be located at any desired point, the only conductors from the meter being a pair of small leads.

The watt-hour meter here shown is of what is known as the "mercury-motor type," because in it mercury is employed to form the electrical contact in place of brushes as used on the commutator type of meter. At the same time the mercury floats the entire moving system and avoids the necessity of employing a lower step bearing. The result is a practically frictionless mercury-floated moving system which cannot be injured by severe shocks or jars, which would soon ruin the usual type pivot-and-jewel bearing. At the same time the absence of

Shunted Watt-Hour Meter.

commutators and brushes renders the meter free from errors due to sparking or tarnishing, inevitable with commutator and brush contacts.

The shunted principle of operation is especially valuable in meters intended for use in large direct-current switchboards where it is desirable to employ watt-hour meters, recording meters and indicating ammeters. These three meters can be operated from a single shunt, thus effecting a saving which in many cases, such as on a 10,000-amp circuit, will amount to several hundred dollars on a single installation. In addition to the economy secured by this method of metering, it is also very desirable in that the meters can be quickly and easily checked without interrupting the main circuit.

The watt-hour meter described above is built by the Sangamo Electric Company, Springfield, Ill.

NEW MOLDED INSULATOR.

The Hemming Manufacturing Company, New York, after a long series of experiments by Emile Hemming, its chemist and the inventor of the well-known "Gummon" and "Hemit" molded insulating materials, is producing a new material which is held to possess great dielectric and tensile strength and all of the elasticity and resiliency of the older forms of shellac compounds, which it is designed to replace, owing to its heat-resisting qualities. This new material is called "Tegit" and, its makers claim, is not affected by temperatures up to 600 deg. Fahr., and is absolutely waterproof, not warping or cracking when subjected to climatic changes. The material, it is stated, has been successfully produced for some time and is being placed on the market only after the manufacturing process has been perfected to a point insuring a standard product.

A STEAM TURBINE FOR DRIVING MODERATE-SPEED GENERATORS.

Although the large-size steam turbine has found application for the driving of alternators and the propulsion of ships, little progress comparatively has been made in its adaptation for driving direct-current generators and for direct connection to other machinery of moderate speed, such as centrifugal pumps and blowers, or for the driving of machinery by means of ropes or belts. While suitable for these purposes because of its simplicity, small weight and space requirements and good steam economy, it is only recently that the problem of driving such machines by steam turbines has been solved. One of the great difficulties the engineers have encountered is the speed-reduction problem. This seems, however, to be satisfactorily solved in the turbine described below.

Fig. 1 illustrates a multi-stage turbine driving a standard-speed, direct-current Crocker-Wheeler generator through a pinion and single gear, the speed at the turbine shaft being 3600 r.p.m. and the speed at the generator shaft 500 r.p.m.

The main casing of the turbine is of cast iron and is split horizontally so that the top half may be lifted off to give access to the revolving and stationary members of the turbine. The casing is supported on a level with the center of the shaft by two pedestals rising from the bedplate, one on each side, and is bolted down only at one end, being free to expand and contract in an axial direction between steel guides. As the endwise position of the shaft is also determined by a thrust bearing at the same end, the results of axial expansion are largely compensated for.

Steam is admitted to the turbine first through a strainer case and then through a combined trip and throttle valve, next through the adjacent governor valve, and then, after passing through steam nozzles of the standard De Laval type, impinges upon the blades of the first-stage wheel. The wheels are all of the standard De Laval type. Upon rebounding from the moving blades the steam again expands by passing between the guide vanes placed all around the periphery of the diaphragm between the first stage and the second stage. These blades are made of "extruded" metal and are fitted onto the cast-iron diaphragm. The diaphragm itself is slightly dished in order to increase its strength to withstand pressure, and to complete it a solid steel band is shrunk over the tips of the guide blades.

The wheels are mounted upon the shaft by split taper sleeves drawn tightly into place by internal nuts in the wheels, and after the wheels are assembled a lock nut on the shaft serves further to secure them, while rotation of the wheels about the shaft is prevented by a key.

The governing mechanism is in duplicate; that is, there is a speed-regulating governor and a speed-limiting or emergency governor. The former is mounted at the top of a vertical shaft driven by a worm gear from the turbine shaft. It is of an extra-heavy, substantial type and controls, through a system of two bell-crank levers and a connecting rod, the movement of a vertical double-seated poppet valve similar to that used on standard De Laval turbines. In order to prevent damage to the valve by overtravel of the governor, a spring is inserted in the connecting rod. The same worm which meshes with the worm wheel on the governor shaft meshes with another worm wheel driving the tachometer. The lower end of the governor shaft is

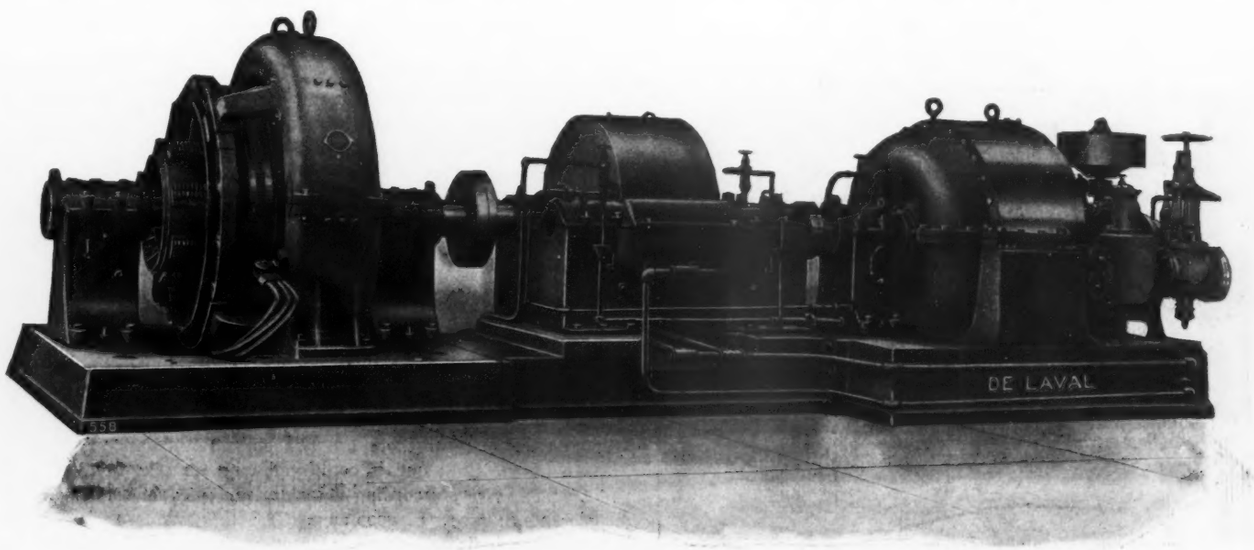


Fig. 1—Turbine Driving Direct-Current Generator.

connected to a pump supplying oil to the bearings of the machine and the pinion and gear.

The emergency governor is located in the end of the turbine shaft itself and is ordinarily not in contact with the trip mechanism. Upon touching the latter steam pressure is at once released from underneath a piston by means of which a toggle gear is released, allowing the combined trip and throttle valve

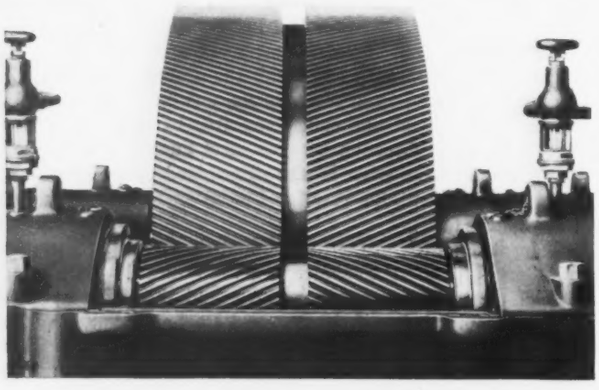


Fig. 2—Pinion and Gear.

to close under the pressure of the steam in the supply pipe. This trip may also be sprung by hand if desired, while the valve spindle is also furnished with a hand wheel and is threaded so that it may be used as a throttle valve independently of the trip.

The bearings of the turbine proper are of the split babbitt-lined type and are supplied with oil through sight-feed oilers from the pump above mentioned.

The pinion and gear, perhaps the most important and interesting part of the construction, are shown in Fig. 2. As will be noticed the gear is of the double helical or herringbone type, differing from the standard gears supplied with De Laval turbines only in size and the fact that only a single gear is used

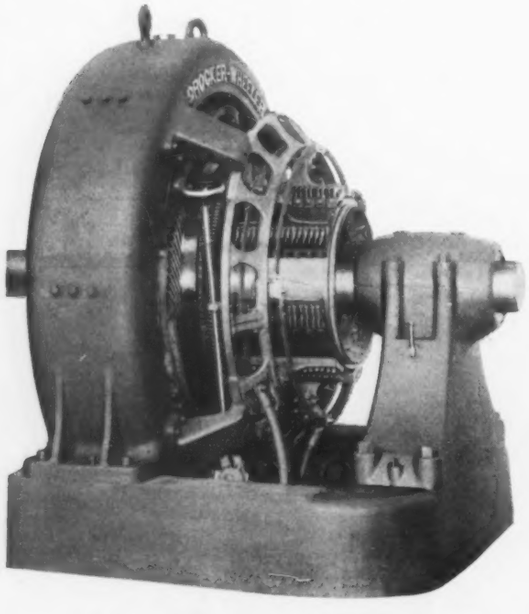


Fig. 3—Commutator End of Generator.

for the largest machines. The pinion is cut from a solid bar of steel and is carried in plain babbitted bearings supported in a rigid cast-iron frame, which also supports the gear bearings. The pinion bearings are lubricated by sight-feed oilers from the pump system, the excess oil overflowing to the wells of the gear bearings, which are ring-oiled. The gear consists of a solid cast-iron center upon which are shrunk two thick steel rings. The hub is mounted on a stiff shaft, which carries at one end a half of the flexible coupling for connection to the driven machine.

The lubrication of the gear and pinion teeth is accomplished by jets of oil directed at the line of contact on the entering side. This oil after use is passed through an oil strainer located in the base of the turbine, then through a cooling and settling chamber and then to the oil well, from which it is again pumped through the circuit.

The operation of the turbo-generator above described is remarkably free from vibration and noise. There is no vibration and no noise that may be overheard at a short distance. The quiet running is attributed to several causes, chief among which is a specially designed gear-cutting machine and the adequate method of lubrication employed.

As stated above, the turbine drives a standard Crocker-Wheeler 500-kw, 500-r.p.m., 250-volt generator. The generator is of the auxiliary-pole type, having eight main poles and eight commutating poles. The windings of the latter are connected in series with the armature circuit and proportioned so as to eliminate sparking through all ranges of load within the rating of the turbine. The shunt-field coils are of impregnated cotton-covered wire. The series-field coils and interpole-field coils are of solid copper bars, formed to shape and insulated from the pole, pole shoe and shunt-field coil by wooden and fiber spacing blocks. The armature coils are of heavily insulated strip copper. They are retained in the slots by wedges and are held down on the heads by band wires. The above-described turbo-generator set has recently been put on the market by the De Laval Steam Turbine Company.

SUBSTATION MACHINERY AND SWITCHBOARD EQUIPMENT OF THE ENGINEERING DEPARTMENT OF THE NATIONAL ELECTRIC LAMP ASSOCIATION.

The work of research, investigation and testing which is carried on by the engineering department of the National Electric Lamp Association makes it necessary that there shall be available a large amount of power, both direct current and alternating current. The machinery and switching apparatus required to handle this must of necessity be varied, and the manner in which some of the problems have been sol ed may be of interest.

The most important part of the equipment is a 300-hp, 2300-volt, 60-cycle synchronous motor running at a speed of 600 r.p.m., which is connected by a flexible coupling to a 120-volt, single-phase generator having a capacity of 1600 amp. Both the motor and the generator are self-contined units with the exciters built into the machines. The purpose of this motor-generator set is to convert the power supply from 2300 volts alternating current, as purchased from the Cleveland Electric Illuminating Company, to 120 volts alternating current for the main feeders to the lamp-test racks, and to permit the introduction of an automatic voltage regulator.

The switching and meter apparatus for this set consists of a compensator for starting the set, an oil switch for the motor, a switch for the field circuit, and meters for indicating field current, field voltage, the main-line voltage and power-factor. For the generator there are two circuit-breakers, one in each side of the line; one is connected with an over-voltage relay operated from a recording voltmeter and both open normally on currents in excess of 2000 amp. The instruments used with the generator indicate voltage, current, wattage and field current—the last being controlled by a separate field switch—and in addition to the indicating meters there is a kw-hour meter for determining the total energy consumed by the lamps on test.

For charging storage batteries and supplying direct current to lamps on the test racks there is used a 30-kw compound-wound, commutating-pole generator direct-connected to a 2300-

volt induction motor which runs at a speed of 1800 r.p.m. For light loads and to obtain 280 volts direct current (which is the highest voltage needed in commercial practice for an individual lamp) there is used a 7-kw motor-generator set consisting of a 440-volt induction motor and a 140-volt direct-current generator, which may be connected in series with the 30-kw machine when the double voltage is desired. When a high voltage is needed, as for battery charging or in case of emergency, a 2-kw booster set may be connected in series with either the 30-kw or 7-kw machine.

The switching apparatus and meters for these three motor-generator sets are as follows: for the 30-kw machine an oil-break switch and a main-line ammeter on the motor side, with ammeters for the line and the exciter, and also a voltmeter to show the voltage on the generator end. The generator field circuit is controlled by a separate switch. There are circuit-breakers for the 7-kw unit, the 2-kw booster and the 30-kw exciter, and instruments showing current and voltage for the 7-kw set and for the booster. The field-rheostat control wheels are all on the board placed directly below the circuit-breakers for the different machines—each machine having its own panel. As the lamp-test racks are fed through transformers direct from the alternator and as the life of the lamps is, of course, dependent on the voltage upon which they are burned, it is necessary that the voltage at which both alternating current and direct current are supplied shall be constant. For this purpose Tirrill regulators are used. The instrument used to control the alternator is fitted with contacts and connections for two machines, although at present only one is in use. The direct-current regulation is maintained by an instrument operating on the field of a small motor-driven exciter.

The storage batteries, which are charged from this plant and which discharge to various parts of the building through the distribution board located in this room, are made up of fourteen sets, as follows: On 140-volt circuits, two sets, 120 amp-hours; three sets, 80 amp-hours; one set, 45 amp-hours; one set, 36 amp-hours; two sets, 30 amp-hours; one set, 24 amp-hours; one set, 6 amp-hours. On 18-volt circuits, two sets, 80-amp-hours. On 14-volt circuits, one set, 24 amp-hours.

In order properly to handle the charging and discharging of these batteries there are used eleven ammeters in the charging circuit, twelve rheostats for regulating charging voltage and eleven amp-hour meters from which may be found the charge required and discharge possible from any set of batteries. The voltage of the batteries—which are located in a battery house 100 yd. away—may be ascertained by the use of a voltmeter plug. Twelve double-pole, double-throw switches are connected to the batteries through the ammeters and amp-hour meters and are

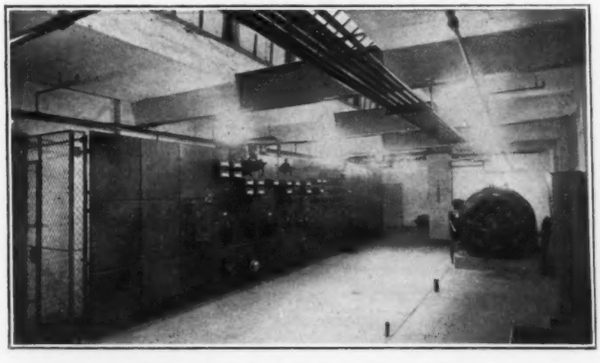


Fig. 1—View of Switchboard and Motor-Generator Sets.

used in charging and discharging. In order to obtain power at various voltages from the 120-amp-hour battery there are "end-cell" switches which allow sixteen cells to be cut out two at a time.

In order to distribute power to the various departments of the building a very extensive plug-board system is employed. There are for this purpose 180 plug receptacles in the power-room, distributed as follows: Incoming alternating current, three pairs, 240 volts; three pairs, 120 volts; three pairs, 60 volts; three pairs, 30 volts; nine pairs, spare; three pairs, test rack room, 0-300 volts; ten pairs, 140 volts; five pairs, 120 volts, and five pairs, 80 volts. Incoming direct current, twelve pairs, 18-130 volts. Outgoing leads, eleven pairs to photometer-room, eight pairs to calibrating-room, eight pairs to

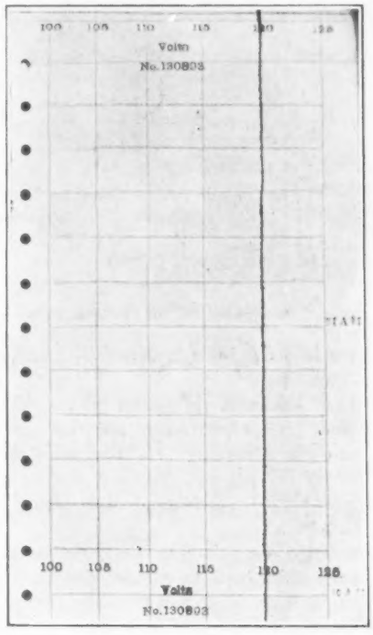


Fig. 2—Characteristic Section of Recording Volt-Meter.

research-room, two pairs to tool-room, one pair to projecting-lantern-room, one pair to blueprint-room and three pairs to physical research laboratory.

As there are a number of intercommunicating lines between the plugboads in the various departments, it is possible, in case of necessity, to supply power to one room through more lines than there are leads to that room from the power-room. The great flexibility of this system and the possibility of using the same leads for a number of kinds of service renders it inexpensive and yet also very satisfactory.

TRANSFORMER-PRINCIPLE ELECTRIC HEATING APPARATUS.

In a new line of electric-heating apparatus devised by Mr. W. K. Freudenberger, of McGill, Nev., the resistance-wire heating element is replaced by a solid piece of plate brass in which large secondary eddy currents are set up by transformer action from a primary winding and core. The brass plate, stamped in the form required, usually annular or rectangular, is quite indestructible under conditions of ordinary use. In applying the transformer principle the body of the appliance is made of iron or steel and constitutes the magnetic circuit of the transformer. The primary coil is placed in a protected position, separated from the secondary ring, which is the heating element, and may be wound with enameled or asbestos-covered copper wire, designed for the ordinary service voltage. The iron or steel body may be a solid casting, stamping or punching, because the usual hysteresis and eddy-current losses are not losses in this case, but are entirely converted into useful heat.

The principle is clearly shown in the sectional sketch of a melting pot for melting solder, babbitt metal, glue, wax, lead and other materials, and for heating soldering irons placed in melted solder or other metal. (Fig. 1.)

The heating element is very thin, has a large surface in

immediate contact with the bottom of the metal pot and requires no insulation, so that the heat is rapidly communicated to the part to be heated. A high efficiency is thus obtained because there is less chance for lateral radiation. On account of the extremely low potential developed in the secondary or

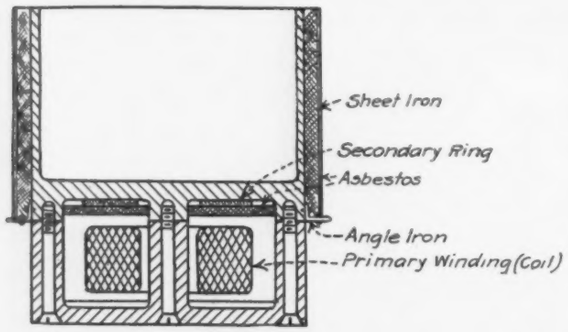


Fig. 1—Section of Melting Pot.

heating element it is not short-circuited by being placed in contact with the metal pot.

Ample thermal insulation is placed beneath the heating element, and around the pot, to retain the heat and thus increase the efficiency of the apparatus. In large sizes flanges are cast at the junction of the pot and base and these parts are bolted together through the flanges instead of by using long tap bolts through the base.

Fig. 2 shows how the principle is applied to an iron. From this it is clearly seen how very near the center of the heat element is the surface of application of the heat. The electric stove is made generally similar to the iron, except that it is

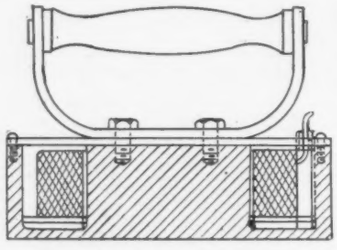


Fig. 2—Section of Flatiron.

virtually turned bottom up and set on legs. The same principle is utilized in immersion heaters, curling-iron heaters, coffee percolators and other apparatus. On account of the heat elements being practically indestructible very high temperatures may be used when desirable and quick work may be done. A patent has recently been applied for by Mr. Freudenberger on the principle involved in this innovation in electric-heating appliances.

DEVELOPMENT IN CURVE-DRAWING ELECTRIC METERS.

By H. S. Baker.

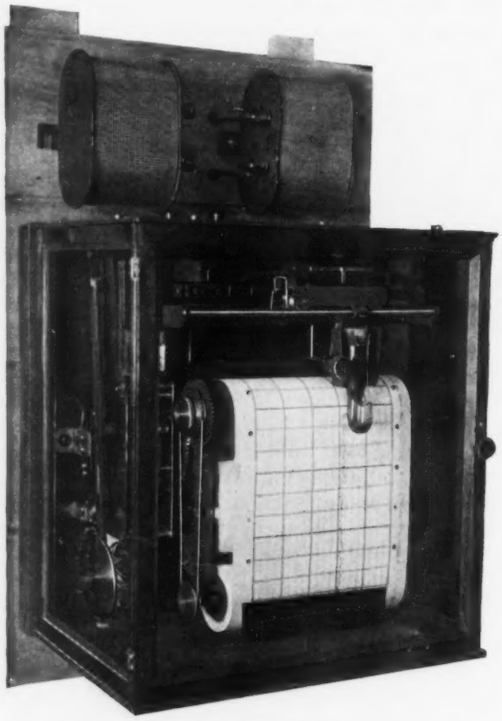
A form of relay type of curve-drawing meter has been developed by the writer, which forms a combination novel in this type of meters.

The principal feature is the combination of a Kelvin balance type of meter element with a moving weight instead of a restraining spring. Practically all previous types of switchboard instruments balance electromagnetic forces against the resilience of springs, and the permanency of those meters is dependent on the permanency of the springs, which are subject to aging, setting and to varying elasticity with temperature variations.

The adaptation of the moving-weight principle to the curve-drawing meter has been very satisfactorily worked out, and the result is a meter more permanent in calibration and zero registration than is the case in some forms of curve-drawing meters. A test under actual operating conditions of several months' duration has warranted the above statement.

As in other relay-type instruments, the measuring element operates electrical contacts which close circuits that energize solenoids, which in turn operate the pen. After the electrical force to be measured has been applied the balance of the "zero-reading" meter element is automatically re-established by the movement of a weight which travels on an arm attached to the meter element.

The movement of the traveling weight is accomplished by a specially designed drag link, which constrains the weight to follow the motions of the pen. The drag link does not in any



Gravity Watt-Balance.

way apply mechanical force to the meter element, which might cause error in the accuracy of its reactions.

The moving-weight principle produces an inherently uniform scale on wattmeters of this type, and when any two points in the scale are correct then all points are correct. Three checks were made upon one of these wattmeters at considerable intervals of time, and the greatest error as read, either in proportionality of scale or in permanency of registration, was 1/7 of 1 per cent of full-scale reading.

The absence of restraining spring and the improved design of knife edges render this instrument sensitive to variations of power of 1/10 of 1 per cent of full-scale reading.

The design of the pen-operating solenoids has been developed so as to reduce to a minimum the amount of power broken at the relay contacts; and, being ironclad, the solenoids are very perfectly protected from affecting the meter element by stray fields. Up to the present time there has been absolutely no contact trouble experienced, and this result is attributed to the small quantity of energy at the breaking contacts.

The instrument embodies many minor features of design of which the need has been felt during the four years' experience of the Ontario Power Company, of Niagara Falls, with previous forms of relay-type graphic meters.

The new meter goes by the trade name of the Baker Gravity Watt Balance, and is placed on the market by Messrs. E. Staebler and F. G. Baker, of Kingston, Can.

Industrial and Commercial News

The Week in Trade.

REPORTS from commercial centers show that there is very little change in the situation which has existed in trade for the last six weeks. Buyers are still extremely conservative, and the orders are small in volume and merely for filling-in purposes. House trade has been to some extent stimulated by liberal cuts that have been made in textiles. Reports from salesmen on the road are only fair, and wholesalers and jobbers complain that what business they are doing at the present time is transacted upon such small margins that profits are far below those of average years. This disappointing situation is offset to a considerable extent by the good crop reports, which indicate that winter wheat is in fine shape and that other crops are progressing satisfactorily. The season has been somewhat late, owing to continued cold weather, but there is every prospect that the acreage, both for cereals and for cotton, will be considerably greater than that of last year. Retail trade has not improved with the progress of the season. In the iron and steel industry mill operations and specifications are reported as satisfactory, although the new business booked for March was not on a par with that done in February. Mills were more actively employed during the past month than they will be, propably, in April. Apparently a good lot of small business is being transacted in structural material, and considerable tonnage is anticipated in connection with the proposed railroad bridge over the East River between Brooklyn and the Bronx. Orders for steel rails are of moderate volume, and equipment orders are very light. Railroads are buying sparingly, and car purchases for the most part are simply to fill in missing numbers. The wire mills are still busy, and there is an active demand for tin plate. In fact, these two branches of the industry are the only ones which have shown any activity, and are the only ones in which no price shading has been reported. Taken as a whole, the reports show that the iron and steel mills of this country are not nearly so busy as those of Canada. Collections continue to be reported only fair. Business failures for the week which ended March 30, as reported by *Bradstreet's*, were 260 as against 235 the previous week, 232 in the same week of 1910, 204 in 1909, 247 in 1908 and 137 in 1907.

The Copper Market.

WIRE-DRAWERS were not quite so anxious to buy copper last week as they were earlier in the month and consequently fewer domestic sales were made. Since the first of the year the demand for bare copper wire has been active and prices have readjusted themselves to the bettered conditions. This has given more stability to the market for electrolytic copper and has discouraged price concessions on the part of the independents. One sale that was reported last week was that of 4,000,000 lb. of electrolytic wire bars, thirty days delivery, at 12¼ cents. The record of the copper market for March has turned out more satisfactory than was at first expected. Exports for the last week of the month were 6522 tons, bringing the exports for the month up to 23,300 tons, or about 52,000,000 lb. The domestic takings are figured to be in the neighborhood of 60,000,000 lb., so that the total deliveries for the month will probably amount to 115,000,000 lb. It is predicted that the production for the month will be about 120,000,000 lb., and if this is correct the increase in the surplus stocks for the month will amount to only about 800,000 lb., which is far less than was anticipated. The major portion of this accumulation will be carried by the Amalgamated interests, as the independents never hesitated to shade prices in order to consummate sales. In Europe there was also a fair volume of business, but as the market was open to very much sharper competition than in this country prices were not so well sustained. It is believed that when the Amalgamated company takes charge of its own selling through the agency of the United Metals Selling Company our market will also become more competitive than at present, and that the big companies will get their full share of business. Imports continue to be heavy. For March they were 12,000 tons. The daily call on the Metal Exchange April 3 quoted standard copper as per accompanying table:

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.70	11.85	.....
March	11.70	11.85	11.77½
April	11.70	11.85	11.77½
May	11.70	11.85	11.77½
June	11.70	11.85	11.77½

The London market, April 3, was as follows:

	Noon.	Closing.
	£ s d	£ s d
Standard copper, spot	54 13 9	54 8 9
Standard copper, futures	55 3 9	55 1 3
	Highest.	Lowest.
Standard	12.30c	11.77½c
London, spot	£56 15 0	£53 15 0
London, futures	57 12 6	54 10 0
Best selected	60 5 0	58 0 0

Industrial and Commercial Notes.

Heavy Order for Oil-Well Motors.—The Westinghouse Electric & Manufacturing Company has recently received an order from the Kern River Oilfields of California, Ltd., calling for the largest number of oil-well motors ever placed in that territory at one time. The order is for early delivery and calls for 100 motors, which will be used for pumping and cleaning the great number of oil wells on the properties of the above company. The motor adopted is of the back-geared type and a pulley on the countershaft drives the main belt. The motors are of the alternating-current variable-speed, continuous-service induction type and will operate on a three-phase, 60-cycle, 440-volt circuit. The motor windings are so arranged that by the simple operation of the switch handle two economical working capacities are obtained. The motors will operate continuously at 10-hp output with high efficiency on pumping service. For cleaning wells they will easily develop 30 hp on intermittent service. For oil-well service this double feature makes this type of motor especially suitable. The results obtained in the way of economy of operation, both as to consumption of power and to cost of maintenance and attendance, as compared with gas and steam operation, will prove of great interest to operators in the oil fields.

Eleventh Avenue Electrification.—Reginald P. Bolton, an engineer, has submitted to the Public Service Commission of the First District of New York an estimate of the cost of electrification of the New York Central Railroad's tracks from Spuyten Duyvil along the Hudson River to Fiftieth Street. Mr. Bolton says that this work can be done for $2,211,017. Mr. Bolton was a witness for George L. Wilson in his action before Commissioner Eustis upon a complaint that the noise and smoke of the steam locomotives so close to Riverside Park was a public nuisance. Mr. Bolton submitted detailed figures of the cost of the electrification. He estimated that the cost of the trackage would be $387,000; transmission and distribution, $250,000; substations and batteries, $679,000, and rolling stock, $573,000. To this he added 20 per cent for engineering and superintendence on the first three items, and 10 per cent on the rolling stock.

A 10,000-kw Waterwheel-Driven Generator.—The greater efficiency, reduction of losses and compactness of the power station gained by the use of large electric generating units have led to the installation of machines of unusual capacity in some of the great power stations. The General Electric Company recently shipped the Pennsylvania Water & Power Company, McCall Ferry, Pa., a three-phase, 10,000-kw, 11,000-volt waterwheel-driven alternator designed to operate at a speed of 94 r.p.m. The shipping weight of this unit was approximately 700,000 lb. and fifteen cars were required for its transportation. It is 27 ft. in diameter and 10½ ft. high. A duplicate is now being shipped. Three 7500-kw generators of the same type, also of General Electric manufacture, are now in service in this plant.

New Stone & Webster Property.—Stone & Webster, of Boston, have perfected plans for the construction of an interurban railway line between Dallas and Waxahachie, Tex., a distance of about thirty miles. Engineers are now in the field and construction work will begin in a few weeks. The line will enter Dallas over the tracks of the Northern Texas Traction Company.

Pacific Power & Light Company.—The Pacific Power & Light Company, of Portland, Ore., operating plants at Walla Walla, North Yakima and The Dalles, has purchased the Hood River Power & Light Company, Hood River, Ore., and the Husum Power Company, on the White Salmon River, Wash. These will form part of the supply for the 250-mile transmission system which the purchasers plan to extend along the Columbia River. The Hood River company was capitalized at $1,000,000, and its bond issue was $76,500. The Husum company was capitalized at $15,000. The equipment of the Hood River plant will be increased from 2500 hp to 3000 hp, and a concrete dam will be built with a view to enlarging the output of the White Salmon plant, which is now rated at 200 hp. The properties will be connected by a cable across the Columbia River. Material has already been ordered for a high-tension line between Hood River and The Dalles, which will bring Hood River, Mosier, White Salmon and The Dalles on one circuit. A high-tension line 121 miles long, to be built this summer from The Dalles to Umatilla, will cross the Columbia to Luzon, extend up the Columbia to Kennewick, meeting the new transmission line now completed from Walla Walla to Kennewick, and from Kennewick will advance to Priest Rapids, in this way connecting all the properties and furnishing sufficient energy for industrial, lighting and irrigation service.

Hudson River Power Companies.—The three receivers of the eight affiliated Hudson River Power Companies which have been in the throes of bankruptcy for the past two and a half years have just made a report of the present condition of the properties. It was the attempt to finance these companies that forced the assignment of E. H. Gay & Company, the Boston banking firm. The report says that the companies are being gradually reorganized, and the figures presented show that, in spite of an unusually dry season last year, the companies were operated at considerably less loss than in 1909. The total income of the companies for the year was $250,072, and the deficit after paying the bond interest was $79,731. The deficit in 1909 was $106,766. The report says that by reason of the low water in the reservoirs last summer it was necessary to spend $45,626 in the purchase of 4,976,501 kw-hours of energy mostly from the Delaware & Hudson. It is also stated that, subject to the approval of the court, an arrangement has been closed with the General Electric Company for the interchange of spare energy when needed, as well as for the settlement of the litigation between the parties. Efforts are now being made to secure legislation providing for the construction by New York State of an immense dam at Sacandaga which will give a constant flow of water to the Hudson River power properties.

Canadian General Electric Company.—The annual report for 1910 of the Canadian General Electric Company, Ltd., which was given out last week, shows net earnings of $911,208, an increase over the previous year of $285,218. After charging $188,088 to depreciation and paying interest amounting to $76,820, the company had a balance available for dividends of $646,300. The report says in relation to the present condition of the company: "Business contracted for during the year was satisfactory, both with regard to volume and price. The unfinished business, upon which no profit whatever has been taken into account, is carried forward to the current year to the value of $4,000,000, and orders are still being received in satisfactory volume. During the year there has been under construction an extensive addition to the machine shop at the Peterborough works. It is expected that this extension will be completed and fully equipped by May 1. This will very materially increase the company's output. In order that the structural steel department may increase its capacity, the company has leased the lands and plant of the Canadian Shipbuilding Company, near Bridgeburg, Ont. While the transaction is in the nature of a lease it has been acquired in the same way as the company acquired its hydroelectric power plant at Nassau some years ago, that is to say, the capital sum of $250,000 will be extinguished by twenty annual payments of principal and interest, so that at the end of twenty years the property will come into the absolute possession of the company without further charge."

Otto Gas Engine Works.—Mr. Frank Salomon has become president and taken entire charge of the management of the Otto Gas Engine Works. Under his administration the entire works and offices have been reorganized and put on a twentieth-century basis. The result has already been increased manufacturing facilities and greater output at less expense, enabling a reduction to be made in the selling cost of the engine, while retaining its high standard of excellence. Mr. Salomon is now turning his attention to the selling organization, and in addition to the branch offices in Chicago, Boston, New York, Pittsburgh, Omaha, Kansas City, Minneapolis and San Francisco he is planning agencies to cover every square mile of territory throughout the country. An extensive campaign of advertising is rapidly maturing, and it is safe to predict that the Otto products will enjoy a wider sale than ever before.

Electric Locomotive for Salt Lake & Ogden.—H. A. Strauss, of Chicago, consulting engineer for the Salt Lake & Ogden Railway Company, has placed an order with the McGuire-Cummings Manufacturing Company, of Chicago, for a 30-ton electric locomotive to handle heavy freight equipment. This is the first of a series of such locomotives which will be placed in operation on this line. The equipment will consist of four 100-hp, 700-volt direct-current General Electric interpole motors, with forced ventilation, with double-end multiple-unit control and Westinghouse combined straight and automatic air brakes. The machine is designed to handle 400 tons trailing load at seventeen and one-half miles per hour. The locomotive proper, including trucks, will be of all-steel construction.

Electric Service Supplies Company.—Contracts for Garton-Daniels lightning arresters have recently been closed by the Electric Service Supplies Company with the Rockford (Ill.) & Interurban Railway Company; St. Joseph (Mo.) Railway, Light, Heat & Power Company; Chicago Railways Company; Birmingham (Ala.) Railway, Light & Power Company; Stark Electric Railroad Company, Alliance, Ohio, and many others. There is a growing tendency of late for operators to purchase lightning protective apparatus early in the season, many even going so far as to purchase arresters in the late fall for use the coming spring.

Electric Pumps for Chicago Water-Works.—The Burke Electric Company, of Erie, Pa., will supply the motors for driving the electric pumps in the West Side pumping station, Chicago, the contract for which has been awarded to the Platt Iron Works Company, of Dayton, Ohio, as mentioned in the *Electrical World* of March 23, page 748. There are to be two centrifugal pumps, each capable of delivering 25,000,000 gal. in twenty-four hours under a total head of 115 ft. They will be direct-connected to two 440-volt, three-phase, 60-cycle synchronous motors rated at 800 kva (1000 hp) each.

Canadian Light & Power Company.—It is reported in Montreal that Canadian Light & Power interests are identified with D. L. McGibbon in his recent purchase of the hydroelectric properties at Cedar Rapids. It is also said that the company is negotiating for other valuable water-power properties in the neighborhood of Montreal. If the plans now formed are carried out the company will have one of the most extensive power propositions in Quebec Province and will become a competitor of the Montreal Light, Heat & Power Company and the Shawinigan Power Company.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Moberly, Mo.; Radford, Va.; Bakersfield, Cal.; Portland, Ore.; Bolton, Miss.; Walker, Ia.; Simpsonville, Ky.; Francesville, Ind.; Fraser, Ia.; Washington, D. C.; Vermilion, S. D.; Anita, Ia.; Winnipeg, Man., Can.; Puebla, Mex.; Port Orchard, Wash.; Ogden, Utah; New York, N. Y., and Carson, Nev.

H. M. Byllesby & Company.—H. M. Byllesby & Company, of Chicago, who operate central stations in various sections of the United States, have just placed an order with the General Electric Company for 5004 electric irons for distribution in the domestic appliance departments of their numerous companies.

Automatic Telephone Service.—President Harris, of the Subway Telephone Construction Company, says that the automatic telephone now has 37,000 subscribers. It was expected that the number of subscribers would reach only 30,000 by April 1.

General Electric Car Equipment Sales.—The Utica & Mohawk Valley Railway Company has purchased from the General Electric Company eight quadruple car equipments for its city service and four quadruple equipments for its interurban service.

Financial.

The Week in Wall Street.

SLUGGISHNESS which has characterized Wall Street trading for the past few months experienced no perceptible variation during the week. The constant repetition of the opinion that no activity can develop until the trust cases are disposed of has practically made this a general belief, as is evidenced by the secondary interest shown in the extra session of Congress, with prospective tariff legislation. To a certain degree this attitude is not unreasonable, since it is felt by many that any changes in the tariff schedules will not, in the main, be disadvantageous, and that reciprocity with Canada will be a benefit. During the week 1,338,224 shares were sold, representing only a fractional increase over the transactions of the previous week, with only slight variations in the majority of prices, indicating that the average day's trading is about as quiet as experienced in the history of the Exchange. As far as the general public is concerned, there seems to be but little interest in Wall Street at the present time for speculative purposes, the majority preferring to seek conservative returns upon investment, as is borne out by the strong tone of the bond market. Ending the first quarter of 1911, the past week has shown little, if any, encouragement for the immediate future. The steel industry in general is believed to be writing business at approximately 60 per cent of capacity. As an indication of the dullness in financial circles it is of interest that municipal bond sales are reported as close to $30,000,000 less for the month than for March, 1910, while there has been a decided falling off in the capitalization of new incorporations. Although it is held in some quarters that conditions do not warrant a hopeful attitude toward improvement, in many cases the opinion is offered that the entire country is slowly recovering from the panic of 1907, that confidence is gradually increasing, and that a period of readjustment to sound business principles will follow the Supreme Court decisions almost irrespective of the trend of the rulings, and that, with a slight impetus, a fair degree of foreign capital should favor the purchase of American securities. Crop indications are reported excellent from all sources, and the money market is in an easy condition. Rates April 3 were: Call, 2@2⅜ per cent; 90 days, 2¾@3 per cent. The quotations in the table are those of the close, April 3.

NEW YORK.

	Mar. 27.	April 3.	Shares Sold.		Mar. 27.	April 3.	Shares Sold.
All. Ch.....	8*	8*	———	Int. Met., pf	53½	53	2,900
All. Ch., pf..	32½	30¼	600	Mackay Cos.	93½*	93½	350
Amal. Cop...	63¾	62⅞	16,300	Mackay C. pf.	76¼	77*	1,000
Am. D. T...	20½*	20½*	———	Man. Elev...	137*	136½	860
Am. Loco...	38½	37¼	630	Met. St. Ry.	15*	15*	———
Am. Loco. pf.	106½*	108	210	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	81*	81*	———	Steel, com...	78⅞	78	210,200
Am. T. & T..	147	144⅜	9,584	Steel, pfd..	119¼	119	3,460
B. R. T....	78⅜	77¾	7,925	W. U. T....	73	73½*	5,275
Gen. Elec...	148½*	148	800	West'h, com.	66½	66½*	1,600
Int. Met....	18¾	18⅝	2,000	West'h, pfd..	120½*	120¼	340

PHILADELPHIA.

	Mar. 27.	April 3.		Mar. 27.	April 3.
Am. Rys.....	44	43⅞	Phila. Elec.....	16⅛	16¼
Elec. Co. of A.....	12*	12	Phila. R. T.....	19¾	19½
Elec. St. B'ty.....	54¼*	53½	Phila. Trac.....	84⅛	84
Elec. St. B'ty., pfd..	30*	30*	Union Trac.....	47⅜	46⅞

CHICAGO.

	Mar. 27.	April 3.		Mar. 27.	April 3.
Chi. City Ry.....	185*	185*	Chi. Tel. Co.....	124	121*
Chi. Rs., Ser. 1....	91½*	90*	Met. El. Co.....	23¾	22⅞*
Chi. Rs., Ser. 2....	24¼*	24	Met. El., pfd.....	69*	69½*
Com. Edison.....	127⅞	128¼	Nat'l Car.....	120	119*
Chi. Subways.....	4½	4⅜	Nat'l Car, pfd.....	120*	119*

BOSTON.

	Mar. 27.	April 3.		Mar. 27.	April 3.
Am. T. & T.....	147	144¾	Mex. Tel.....	3½*	3⅜*
Cum. Tel.....	150*	147*	Mex. Tel., pfd.....	6½	6½*
Edison E., Ill.....	286	282	N. E. Tel.....	144	144½*
Gen. Elec.....	148¾*	148¾	W. T. & T.....	20*	20
Mass. E. Ry.....	17½*	17½*	W. T. & T., pfd...	93½*	93½
Mass. E. Ry., pfd..	87½	87¾*			

*Last price quoted.
Shares sold for week, March 27 to April 1.

Financial Notes.

Western United Gas & Electric Company.—Six per cent gold debentures of the Western United Gas & Electric Company, of Aurora, Ill., to the amount of $600,000, are offered for sale by the company's bankers. These debentures represent a short-time loan, being dated Feb. 1, 1911, and redeemable serially up to Feb. 1, 1918. The company's principal business relates to the distribution of gas, but it also supplies electrical energy in Aurora, Wheaton, Glen Ellyn and Montgomery. The company has $1,500,000 of preferred stock authorized and outstanding and $5,000,000 authorized common stock, of which $3,000,000 is outstanding. It is authorized to issue $5,000,000 in bonds, and of these $3,885,000 are outstanding. For the year ended Jan. 31, 1911, its gross earnings were $1,230,273, and operating expenses and taxes $775,344, leaving a net income of $455,029. The interest on outstanding bonds was $178,950, leaving a net surplus of $276,079. I. C. Copley, of Aurora, is president of the company, and the majority of the capital stock is owned by the management and local capitalists in Aurora and Joliet. The American Gas Company, of Philadelphia, is also a large stockholder. A modern steam-turbine electric generating station of 2200-kw rating is located in Aurora. Gas-making plants are maintained at Joilet, Aurora, Elgin and La Grange. Connected with the company's distributing mains are 33,658 gas meters and 2182 electric meters. The present issue of debentures is offered par and accrued interest.

Great Western Power Company.—Negotiations have been concluded by the Great Western Power Company for the purchase of the plant of the City Electric Company, San Francisco. The rating of the plant is approximately 22,500 kw. A ninety-day option at $150,000 was taken by the Great Western Company and has now been closed. An investigation of the property will be made, and if found satisfactory a first payment of 20 per cent of the purchase price of $4,000,000 will be made, to be followed by further payments of 20 per cent at intervals of three, six and nine months. The outstanding capital stock of the City company is $5,000,000.

Northern New York Telephone Merger.—The merger of the Bell and Independent telephone interests in Rochester and the territory east to Syracuse is still being held up owing to the inability of the Friendship Telephone Company, representing the New York Telephone Company, to purchase the stock of the Rochester Telephone Company, which is an independent concern. As stated in our last issue, Independent interests in Buffalo own a considerable portion of the stock of the Rochester company and are trying to prevent a sale to the Bell interests, which would isolate the Independent company in that city.

Municipal Light & Power Company, San Francisco.—Articles have been filed in San Francisco for the incorporation of the Municipal Light & Power Company, with $1,000,000 capital stock. The directors of the new company were named as: P. S. Scales, San Mateo; J. H. Sandford and Rudolph Spreckels, San Francisco; Frank Harrold, Fruitvale, Cal., and Claus A. Spreckels, New York. It is believed that the new company is in the nature of a reorganization of the Municipal Light & Power Company, which existed for several years as a part of the Spreckels estate.

Long Island Lighting Company.—A petition has been presented to the Public Service Commission of the Second District, signed by the Amityville Electric Light Company, the Northport Electric Light Company and the Islip Electric Light Company, asking for authority to merge into the Long Island Lighting Company, with a capital stock of $300,000 and an authorized bond issue of $6,000,000 5 per cent bonds, of which $370,000 would be issued at the present time. The two companies first named are now operating concerns.

Washington & Rockville Railway Company.—The United States Circuit Court at Baltimore has appointed George W. Williams receiver for the Washington & Rockville Railway Company, a line eleven and a half miles long, from the capital to Rockville, Md. The receiver was appointed upon the application of the Washington Railway & Electric Company, which holds the bonds of the smaller company.

Bell Telephone Company of Canada Bonds.—Lee, Higginson & Company, who recently purchased an issue of $1,250,000 5 per cent bonds of the Bell Telephone Company of Canada, announce that the offerings of these securities in Montreal and London were more than two and a half times over-subscribed. The bonds were offered at 102 and interest. No offering was made in the United States.

Shore Lighting Company.—The Board of Public Utilities of New Jersey has approved the proposed merger of the Shore Electric Company, of Red Bank; the Seabright Electric Company and the Citizens' Light & Fuel Company, of South Amboy, into the Shore Lighting Company. The new company will be authorized to issue $400,000 5 per cent bonds.

Proposed Merger of Elevated Roads in Chicago.—The proposed merger of the four elevated railroad companies in Chicago is still hanging fire, although Henry A. Blair and other men interested in the project hope that it will go through. It is said that the financing of the project will involve the provision of more than $40,000,000.

Cumberland Telephone & Telegraph Company.—A circular has recently been issued by a brokerage firm in Nashville, Tenn., showing the wonderful growth of the Cumberland Telephone & Telegraph Company during the past fourteen years. The net earnings for the year 1910 were $2,407,268, an increase of $250,000 over the previous year, and the company's surplus at the end of the year amounted to $6,844,409. At the beginning of the present year the company operated 554 exchanges and served 218,557 subscribers. Speaking of the value of the Cumberland company's stock as an investment, the circular says: "Of all the subsidiary companies of the American Telephone & Telegraph Company there are none better than the Cumberland, for the reason that it covers one of the largest and most profitable territories, an area of over 175,000 square miles with practically no competition; and, as already stated, over 90 per cent of its franchises are perpetual and unrestricted. The net earnings average 12 per cent the year round. It is for these reasons that the stock of the Cumberland sells higher than its parent company."

Northern Ohio Traction & Light Company.—W. E. Hutton & Company, of New York, are offering $1,000,000 preferred stock of the Northern Ohio Traction & Light Company at 97½, yielding 6.15 per cent per annum. The proceeds will be used for the construction of a combined steam and hydraulic power station to supply energy to Akron, Ohio, and to take care of the increasing demand for motor service in the other sections served by the company. The Northern Ohio Traction & Light Company system comprises 215 miles of street railway operating in the cities of Akron, Canton and Massillon, connecting these cities, and extending to Cleveland, Barberton, Ravenna, Kent, New Philadelphia, Canal Dover and Dennison, and the electric lighting systems in Akron and Barberton, serving a population outside of Cleveland of 190,000.

Baltimore Public Utilities.—It is reported in Baltimore that shares of the United Railways & Electric Company are being accumulated in the interest of James E. Aldred, the president of the Pennsylvania Water & Power Company and the Consolidated Gas, Electric Light & Power Company. It is reported that Mr. Aldred and his associates are buying in United in order to further the merger of the power companies controlled by Mr. Aldred and the United company, thus bringing under one control the public-utility companies of Baltimore with the exception of the Washington, Baltimore & Annapolis Electric Railroad and the telephone company. The report has created a fresh outburst of activity in United Railway & Electric Company common stock.

Great Falls Power Company.—The Guaranty Trust Company, of New York, has purchased $4,000,000 thirty-year 5 per cent bonds of the Great Falls Power Company, of Montana. The company has a hydroelectric development at Great Falls, on the upper Missouri River, of about 47,000 hp capacity, and ha transmission lines to Butte and Anaconda. The company also owns undeveloped water-power properties capable of generating 100,000 hp. The company expects eventually to have sufficient demand from the railroads crossing the Rocky Mountains for all the energy it can produce. It is claimed that the company can produce energy at a lower cost than any other plant in the country. John D. Ryan organized and controls the company.

American Telephone & Telegraph Meeting.—At the annual meeting of the American Telephone & Telegraph Company the old board of directors was re-elected, including Lewis C. Ledyard and Norman W. Harris, who were elected during the year, succeeding G. L. Green and G. W. Persen, retired. The retiring officers were also re-elected. At the meeting 1,448,028 shares were voted. President Vail stated that business for the present year was up to the level of a year ago, and that the outlook is very promising for about the same percentage of increase in 1911 over 1910 as was shown in 1910 over the previous year.

Fonda, Johnstown & Gloversville.—Ladenburg, Thalmann & Company and A. B. Leach & Company, of New York, have purchased the balance of the 4½ per cent bonds of the Fonda, Johnstown & Gloversville Railroad Company. These bonds were recently authorized by the Public Service Commission of the Second District of New York and are tax-exempt in the State of New York. The report of the company for 1910 shows an increase in net earnings of almost 50 per cent over the preceding year. The company is paying 6 per cent upon its preferred stock and 2 per cent on its common.

Canadian Westinghouse Company.—The net earnings of the Canadian Westinghouse Company for the year ended Dec. 31, 1910 were $697,393. A dividend of 7 per cent was paid on $4,376,600, the capital stock outstanding, and the total reserve at the end of the year was $1,176,000. This is a decided betterment over the previous year, over 40 per cent more business being done in 1910 than in 1909. The retiring directors and officers were all re-elected, including George Westinghouse as president and Paul J. Myler as vice-president and treasurer, while F. A. Merrick was elected general manager.

New York Electrical Companies.—The statistician of the Public Service Commission of the First District of New York has just issued the operating figures of the New York Edison Company and the Edison Electric Illuminating Company of Brooklyn for the year 1910. These show that the net corporate income available for dividends of the New York Edison Company was $5,821,346, an increase of $1,101,538 over 1909, and for the Brooklyn company was $38,245. The detailed figures are given in another column of this issue.

Public Service Corporation of New Jersey Dividend.—The Public Service Corporation of New Jersey has declared a dividend of 1½ per cent, which places the stock on a 6 per cent basis, an annual increase of 1 per cent over the former rate.

DIVIDENDS.

Associated Gas & Electric Company, quarterly, preferred, 1½ per cent, payable April 15.

Boston Suburban Electric Companies, quarterly, preferred, $1 per share, payable April 15.

Cincinnati, Newport & Irvington Light & Traction Company, quarterly, preferred and common, 1⅛ per cent, payable April 15.

Commonwealth Gas & Electric Companies, quarterly, preferred, 1¼ per cent, payable April 15.

Dallas Electric Corporation, semi-annual, first preferred, 3 per cent; second preferred, 2 per cent; payable April 10.

Electrical Utilities Corporation, quarterly, 1¼ per cent, payable April 15.

Fort Smith Light & Traction Company (Ark.), quarterly, preferred, 1¾ per cent, payable April 15.

Marlborough Electric Company (Mass.), quarterly, 2½ per cent, payable April 15.

Milwaukee Electric Railway & Light Company, quarterly, preferred, 1½ per cent, payable May 1.

Northern States Power Company, quarterly, preferred, 1¾ per cent, payable April 15.

Oklahoma Gas & Electric Company, Oklahoma City, quarterly, preferred, 1¾ per cent, payable April 15.

Ottumwa Railroad & Light Company (Ia.), quarterly, preferred, 1¾ per cent, payable April 15.

San Diego Consolidated Gas & Electric Company, quarterly, preferred, 1¾ per cent, payable April 15.

United Gas Improvement Company, quarterly, 2 per cent, payable April 15.

REPORTS OF EARNINGS.

AMERICAN CITIES RAILWAY & LIGHT COMPANY.

Period.	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
Year, 1910.....	$893,185	$40,967	$852,217	.....	$7,407
Year, 1909.....	714,244	28,082	686,162	.....	2,769

BELL TELEPHONE COMPANY OF MISSOURI.

Year, 1910.....	$2,068,245	$1,491,719	$576,526	.....	.....
Year, 1909.....	1,984,156	1,273,586	710,570	.....	.....

KEYSTONE TELEPHONE COMPANY OF PHILADELPHIA.

Feb., 1911.....	$94,484	$46,658	$47,826	$24,267	$23,559
Feb., 1910.....	95,194	49,347	45,847	25,702	20,145

LAKE SHORE ELECTRIC RAILWAY COMPANY.

Feb., 1911.....	$76,258	$48,131	$28,126	$34,782	*$6,655
Feb., 1910.....	70,876	47,275	23,600	34,847	*11,246

MONTREAL STREET RAILWAY COMPANY.

Feb., 1911.....	$330,737	$227,604	$103,133	$41,974	$61,159
Feb., 1910.....	303,977	204,255	99,722	39,875	59,846

NEW YORK EDISON COMPANY.

Year, 1910.....	$18,051,106	$10,685,241	$8,516,374	$2,695,060	$5,821,346
Year, 1909.....	16,553,257	9,810,555	7,746,732	3,026,925	4,719,807

NORTHERN OHIO TRACTION & LIGHT COMPANY.

Feb., 1911.....	$172,413	$104,868	$67,544	$44,357	$23,187
Feb., 1910.....	146,206	92,513	53,693	43,291	10,401

SYRACUSE RAPID TRANSIT RAILWAY COMPANY.

Qr., Dec., 1910..	$400,036	$266,749	$133,287	$90,152	$37,162
Qr., Dec., 1909..	368,013	268,410	99,604	95,489	4,115

TRI-CITY RAILWAY & LIGHT COMPANY.

Year, 1910.....	$2,513,487	$1,481,967	$1,031,520	$481,408	$550,112
Year, 1909.....	2,039,488	1,140,907	898,581	472,388	426,193

UNITED RAILWAYS OF ST. LOUIS.

Feb., 1911.....	$863,990	$607,242	$260,039	$230,689	$29,350
Feb., 1910.....	804,314	587,168	220,271	233,113	12,842

UNITED RAILROADS OF SAN FRANCISCO.

Feb., 1911.....	$577,582	$343,775	$233,807	.....	.....
Feb., 1910.....	570,983	343,879	227,104	.....	.....

*Deficit.

General News

Construction News.

DECATUR, ALA.—The City Council is reported to be contemplating the construction of an electric light plant.

CUMMINS, ARK.—The installation of an electric light plant with sufficient output to supply electricity for 200 lamps at the State convict farm is reported to be under consideration by the Board of Penitentiary Commissioners. John H. Page, of Little Rock, Ark., is secretary.

DE WITT, ARK.—It is reported that L. E. Faynter, of Medora, Ill., is considering the installation of an electric light plant in De Witt.

GURDON, ARK.—J. B. and J. G. Gresham are reported to have been granted a franchise by the City Council to construct and operate an electric light and water-works plant in Gurdon for a term of thirty years.

MONTICELLO, ARK.—The contract for equipment for the municipal electric light plant was awarded to the Ball Engine Company, of Erie, Pa., for $11,725, and calls for the installation of a Westinghouse generator. Oglesby Brothers, of Monticello, have the contract for construction of the power house, to be built of concrete. The plant was destroyed by fire about six weeks ago.

SILOAM SPRINGS, ARK.—The City Council has decided to make improvements to the municipal electric light plant and establish a twenty-four-hour service, involving an expenditure of about $5,000. It is understood that contracts have been placed for machinery and equipment needed.

BAKERSFIELD, CAL.—The electric plant of the San Joaquin Light & Power Company was damaged by fire on March 22, causing a loss of about $25,000. It is said that the fire was caused by the breaking down of a transformer, causing the burning out of a 750-kw generator.

BAKERSFIELD, CAL.—The San Joaquin Light & Power Company has completed its transmission line from Bakersfield to Taft, through the West Side oil fields, and will soon be in a position to supply electricity to operate the oil drills in that section. The new line will form a loop from Fresno to Bakersfield passing through the Coalinga and Kern River oil fields. The erection of substations at Famosa, Wasco and other points is contemplated. The company is contemplating increasing its plant in Bakersfield by 6667 hp, at a cost of about $250,000. Orders have already been placed for boilers and generator. A. G. Wishon, of Fresno, Cal., is general manager.

BAKERSVILLE, CAL.—Announcement has been made by the San Joaquin Light & Power Company of a reduction in the price of electricity and gas in Bakersfield to take effect from April 1. The present rates for electricity are on a basis of 20 cents per kw-hour with a discount allowed on bill, while the new rates are to be based upon the hours which the installed capacity of electrical equipment is used, and are graduated in this classification from 12 cents per kw-hour down to 4 cents per kw-hour. The rate for electrical energy for motors, which at present is 8 cents down to 2 cents per kw-hour, will be reduced to 6 cents down to 1½ cents per kw-hour.

BERKELEY, CAL.—Initial steps toward the reduction of light and water rates in this city have been taken by the City Council. Councilman McClure has been authorized to secure estimates on the cost of establishing and maintaining a municipal electric light plant. The conference committee of the allied improvement clubs of Berkeley has asked for a reduction of 33⅓ per cent in the price of water; from 9 cents to 7 cents per kw-hour for electricity and for gas from $1 to 90 cents per 1000 cu. ft.

LOS ANGELES, CAL.—Koebig & Koebig, engineers, 902 Broadway Central Building, Los Angeles, Cal., have been engaged by the Ramona Power & Irrigation Company to take charge of the construction of its proposed system. The project will involve an expenditure of about $2,500,000.

LOS ANGELES, CAL.—The San Joaquin Light & Power Company has authorized a bond issue to the amount of $25,000,000, the proceeds to be used for the purpose of establishing an extensive irrigation and reclamation project in the San Joaquin Valley. The proposed work will include the construction of power dams in the Sierra Nevada Mountains and the erection of transmission lines, covering the country between Bakersfield and Merced, for the purpose of supplying electricity to operate pumps for irrigating purposes and for reclamation work. The main office of the company is located in Los Angeles. A. G. Wishon, of Fresno, Cal., is general manager.

MADERA, CAL.—The City Trustees are reported to be considering the question of installing an electric plant to supply electricity to operate the pumping stations of the new water works and for street lighting.

OAKLAND, CAL.—The City Council has granted the Oakland Traction Company a franchise to construct and operate an electric railway on Hopkins Street from Fruitvale Avenue to Redwood Road, for which the company paid $1,000. The company also agrees to maintain lamps along the line of the proposed railway.

OROVILLE, CAL.—Notice of appropriation of 150,000 in. of water in the north fork of the Feather River has been filed by William S. Cone and Lloyd P. Cornehl. Mr. Cornehl is an engineer in the employ of the Great Western Power Company.

PORTERVILLE, CAL.—The Tulare County Power Company is planning to erect a transmission line to connect Porterville with Visalia, Exeter, Lindsay, Strathmore and Tulare. C. H. Holley, manager, is making contracts with farmers in this vicinity. It is understood that the service is to begin by Jan. 1, 1912.

SACRAMENTO, CAL.—Plans are being made by the Natomas Consolidated Company for the construction of a large irrigation system to reclaim a large tract of land north of Sacramento. The project includes the construction of an electric railway from the heart of the district to this city.

SAN BERNARDINO, CAL.—Notice of appropriation of 3800 in. of water in San Bernardino County has been filed by H. W. Dennis, engineer, of Los Angeles, Cal., representing the Union Power Company. It is proposed to develop the water-power to generate electricity for transmission to Los Angeles and other cities and towns. The water will be conveyed to the power house by means of cement conduits and canals, 3 ft. wide and 5 ft. deep.

SAN FRANCISCO, CAL.—It is reported that negotiations have been closed whereby the Great Western Power Company has purchased the property of the City Electric Company. The consideration is said to be $4,000,000. Edwin Hawley, of New York, N. Y., is president.

STOCKTON, CAL.—The Board of Supervisors has granted the San Joaquin Valley Electric Railway Company a franchise along McKinley Avenue from Stockton to French Camp. L. Brackett is interested in the company.

STOCKTON, CAL.—The Tidewater & Southern Railroad Company has commenced work on construction of its proposed electric railway to connect Stockton, Atlanta, French Camp, Escalon, Modesto, Cens and Turlock, forty-four miles in length. The company also proposes to supply electricity for lamps. K. C. Brueck, of Stockton, Cal., is president.

MIDDLETOWN, CONN.—The State Legislature has passed a bill authorizing the Middletown Electric Light Company to increase its capital stock to $500,000.

NEW LONDON, CONN.—The New London Gas & Electric Company has been granted permission by the State Legislature to supply steam heat and to lay conduits and mains for distribution of either steam or hot water.

SIMSBURY, CONN.—A bill has been passed by the State Legislature permitting the Simsbury Electric Company to increase its capital stock from $10,000 to $20,000.

WILMINGTON, DEL.—The Wilmington & Philadelphia Traction Company has been granted a franchise by the Street and Sewer Department to erect transmission lines in Wilmington to supply electricity for lamps and motors in this city. Under the terms of the franchise the company is to pay the city 2 per cent of its gross earnings, and to furnish electrical service at a maximum rate of 10 cents per kw-hour.

WASHINGTON, D. C.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until May 1 for furnishing and installing lighting fixtures in the United States buildings at Columbus, Neb.; Fort Dodge, Ia.; Hattiesburg, Miss.; Kansas City, Kan.; Lander, Wyo.; Helena, Ark.; Meridian, Miss., and Sacramento, Cal., in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is Supervising Architect.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 29, 1911, for furnishing and installing six 450-hp water-tube boilers, equipped with oil-burning apparatus, superheaters, a flue and a stack; also one 3000-cu. ft. air-compressor with intercooler, aftercooler and air receiver for the central power plant at United States Naval Station, Pearl Harbor, Hawaii. Plans and specifications can be obtained on application to the above bureau or to the commandant of the naval station named. The cost of the boilers and appurtenances is estimated at $75,000 and of air compressor at $13,500. R. C. Hollyday is chief of bureau.

FORT LAUDERDALE, FLA.—The Fort Lauderdale Ice & Light Company, recently incorporated with a capital stock of $50,000, it is reported, will install an electric light plant. Henry R. Brown is president.

TAMPA, FLA.—C. W. Alton, of Anderson, Ind., is reported to be interested in a project to build an electric railway from St. Petersburg to Tampa, Fla.

BARNESVILLE, GA.—At an election to be held April 18 the proposition to issue bonds to the amount of $50,000, the proceeds to be used for extensions to the municipal electric light plant, water works, sewer systems and other improvements, will be submitted to a vote.

CANTON, ILL.—The Home Telephone Company, of Canton, Ill., is

contemplating the erection of additional cable lines. M. J. Gorman is president.

CONCORD, ILL.—It is reported that steps have been taken toward the construction of an electric railway to connect with the Hawley system at Keokuk and the McKinley system at Carlinville. At a mass meeting held recently in Exeter it is said that subscriptions to $30,000 in capital stock were secured. The proposed railway would cross the river at Meredosia, requiring the construction of a bridge at that place. The Concord Oil & Gas Syndicate, of Concord, Ill., is reported to be interested in the project.

GALESBURG, ILL.—The Galesburg Union Telephone Company is contemplating the installation of a new automatic switchboard.

SPRINGFIELD, ILL.—The appropriation bill introduced in the State Legislature by Senator Dunlap includes an appropriation of $50,000 for the enlargement of the lighting plant and $1,500 per year for the extension of the telephone system at the University of Illinois, Urbana.

CONVERSE, IND.—The construction of an electric railway to connect Converse and Somerset, Ind., is reported to be under consideration by local business men. L. O. Arnold, of Converse, Ind., is reported to be one of the promoters.

CRAWFORDSVILLE, IND.—The Commercial Club and the Mutual Credit Exchange are interested in the movement to secure a new street lighting system for the city.

FORT WAYNE, IND.—The Board of Public Works is conducting a series of tests of tungsten lamps and the Wood Magnetite lamp for the purpose of installing an ornamental street lighting system. A committee has reported in favor of the tungsten lamp, which has aroused considerable opposition and the competing companies will be allowed to install test lamps.

FRANCESVILLE, IND.—The Town Trustees have granted F. L. Kleckner, representing the Aurora Electrical Company, of Aurora, Ill., a franchise to install an electric light plant in Francesville. It is understood that the plant will be driven by gas engines.

INDIANAPOLIS, IND.—The City Council is considering an ordinance providing for placing all wires underground in the central portion of the city, within a radius of a mile square or more.

INDIANAPOLIS, IND.—Contracts will soon be awarded by the Cincinnati, Madison & Western Traction Company for the construction of forty-one miles of track. A subsidy tax of $100,000 has been voted the railway. The proposed railway will connect Madison, Scottsburg and Lexington. J. E. Greeley, of Louisville, Ky., is president.

INDIANAPOLIS, IND.—The Indianapolis & Seymour Traction Company, recently organized, is reported to have applied for franchises through Greenwood and Southport. Grafton Peck, A. O. Kelly and W. H. Todd, of Greenwood, are interested in the project.

JASONVILLE, IND.—The Jason Leader is preparing to install additional power machinery, including an electric generator.

RICHMOND, IND.—It is reported that a company is being organized under the name of the Eastern Indiana Traction Company for the purpose of building an interurban railway from Richmond, Ind., to Cincinnati, Ohio, passing through Liberty, Brookville and Harrison, Ohio. The company will be capitalized at $1,000,000. The incorporators are: A. M. Gardner, Paul Comstock, of Richmond, Ind.; Dr. E. L. Beard, of Liberty; R. L. Head, of Brookville, and F. J. Brinkman, of Harrison, Ohio.

RUSHVILLE, IND.—Plans are being made to install an ornamental street lighting system in Rushville.

ANITA, IA.—The W. K. Palmer Company Engineers, Dwight Building, Kansas City, Mo., has been engaged by the town of Anita to take charge of the installation of a municipal electric light plant and remodeling the water-works system, to cost approximately $30,000.

CLARION, IA.—It is reported that the local electric light plant has been purchased by M. E. Mozengo and W. H. Carr. It is understood that the new owners will make improvements to the plant and establish a day service.

DES MOINES, IA.—Permission has been granted the receivers of the Fort Dodge, Des Moines & Southern Interurban Railway by Judge Smith McPherson in the Federal Court to expend $500,000 on its system.

ELDORA, IA.—The Park Dam Power Company has been granted a franchise to install an electric light and power plant in Eldora. The cost of the plant is estimated at about $10,000.

FRASER, IA.—It is reported that the Fort Dodge, Des Moines & Southern Railroad Company is planning to build a power plant in Fraser, to cost approximately $48,500. It is said that the entire system will be equipped with automatic safety signals.

WALKER, IA.—At a special election held March 20 the citizens voted to light the streets of the town by electricity. The electric plant will be installed by Mr. Cross, of Monticello.

HENDERSON, KY.—Surveys are being made by H. U. Wallace & Company, of Chicago, Ill., for the proposed electric railway of the Henderson Interurban Railway Company, which is to connect Henderson, Owensboro, Uniontown, Morgan Field, Sebree, Dickson and Providence. Malcolm Yeaman, of Henderson, Ky., is president, and E. F. Wheaton, of Nashville, Tenn., vice-president and general manager.

SIMPSONVILLE, KY.—The Lincoln Institute has awarded a contract to the George Rommel Company, of Louisville, Ky., for the construction of eight buildings to be erected on a site secured by the institute near Simpsonville. The project includes a power house and equipment, as the institute will build and operate its electric light and water-works plants. W. H. Frost, president of Berea College, at Berea, Ky., is interested in the project.

ANNAPOLIS, MD.—The Commissioners of Anne Arundel County have awarded a contract to the Consolidated Gas & Electric Light Company, of Baltimore, to furnish electricity for lamps in Brooklyn, Curtis Bay and other sections of the Fifth district contiguous to Baltimore for a period of five years. Under the terms of the contract the company is to furnish arc lamps at the rate of $77 each per year; 40-cp incandescent lamps at $26.75 per lamp per year; 60-cp incandescent lamps at $30.75 each per annum; 80-cp incandescent lamps at $34.50 each per year and 200-cp incandescent lamps at $67.25 per lamp per year.

BALTIMORE, MD.—Bids will be received by Board of Awards, care J. Sewall Thomas, city register, City Hall, Baltimore, Md., until April 12, for furnishing 1,000,000 duct feet of vitrified tile conduit; 200,000 ft. of special duct pipe, including bends for use of the Electrical Commission. Raleigh C. Thomas is city engineer.

SALEM, MASS.—The City Council has awarded the contract for street lighting to the Salem Electric Lighting Company for a period of five years, under the terms of which the company is to supply 25 magnetite arc lamps, 225 6.6-amp arc lamps and 700 tungsten lamps of 60 cp, for $36,750 per year. Under the new contract the city will save about $6,000 per year.

SHELBURNE FALLS, MASS.—A movement is on foot in Ashfield and Buckland to light the streets of the towns by electricity. The town of Ashfield has voted to appropriate $600 for street lamps and Buckland $250. It is proposed to secure the service from the Shelburne Falls plant of the Greenfield Electric Light & Power Company. The proposed transmission line will go through Apple Valley, where it is expected that farmers along the line will utilize the service.

SHERBORN, MASS.—The town of Sherborn has entered into a ten-year contract with the Edison Electric Illuminating Company of Boston for street lighting, giving the company the right to extend its commercial service through the streets of the town.

SOUTH FRAMINGHAM, MASS.—At a special election held recently the proposition to install a municipal electric light plant was defeated.

WORCESTER, MASS.—The Spencer Wire Company, of Worcester, Mass., is reported to be considering erecting an addition to its plant at Worcester, 80 ft. x 400 ft., three stories high. It is understood that the company will purchase electrical energy for operating the machinery in the new building, instead of enlarging its power plant.

TOWER, MINN.—The question of issuing bonds to the amount of $16,000, the proceeds to be used for the construction of a hydro-electric power plant at Pike Falls, is reported to be under consideration.

BOLTON, MISS.—The electric light and water-works plant was destroyed by fire on March 19. Steps will be taken at once to rebuild the plant, as the town is at present without water and lighting service.

JEFFERSON CITY, MO.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until April 25 for conduit and wiring and gas piping systems at the United States post office and court house at Jefferson City, Mo., plans and specifications for which may be secured at the above office or at the office of the custodian, Jefferson City, Mo. James Knox Taylor is Supervising Architect.

KANSAS CITY, MO.—Plans are being considered by the Kansas City, Ozark & Southern Railway Company for the construction of an extension from Kansas City to Forsyth and Hollister, via Brown Branch, Bradleyville, Kisee's Mills, Kirbyville and Mansfield, about thirty-five miles in length.

MOBERLY, MO.—Sealed bids will be received at the office of the Board of Public Works, Moberly, Mo., until April 20 for furnishing and installing material and equipment for improvements and extensions to the water-works and electric light systems as follows: Two four-valve, high-speed, automatic engines; two 75-kw, 2300-volt, alternating-current generators for direct connection to engines, complete with exciters; one 2,000,000-gal. crank and flywheel pumping engine; three horizontal, high-pressure return tubular boilers, with a rating of 125 hp each; one 400-hp feed water heater and boiler feed pump heads for two wells already sunk; one switchboard; one brick smokestack, 85 ft. high; construction of power house and erection of street-lighting system, etc. Plans and specifications are on file at the above office and at the office of Rollins & Westover, consulting engineers, Beals Building, Kansas City, Mo. H. A. Hatfield is president of Board of Public Works.

GREAT FALLS, MONT.—The farmers of Smith River Valley have organized a telephone company to construct a 15-mile telephone line to make connection with this city and other sections of the State, work on construction of which will begin at once. I. K. Huntzberger is president of the company.

LAVINA, MONT.—The cost of installing an electric light plant and water-works system in Lavina is estimated at $35,000 to $41,000 by the Lewiston Engineering Company, of St. Paul, Minn.

CARSON, NEV.—Sealed proposals will be received at the office of the United States Reclamation Service, 605 Federal Building, Los Angeles, Cal., until April 17, for furnishing a 72-in. penstock for the Truckee-Carson project. For particulars address the above office, or the United States Reclamation Service, Department of the Interior, Washington, D. C. F. H. Newell is director.

CARSON, NEV.—Sealed bids will be received at the office of the United States Reclamation Service, 605 Federal Building, Los Angeles, Cal., until April 13 for furnishing electrical apparatus for the Truckee-Carson project, Nevada. For further particulars address the above office, or United States Reclamation Service, Department of the Interior, Washington, D. C. F. H. Newell is director.

CARSON, NEV.—Bids will be received at the office of the United States Reclamation Service, 605 Federal Building, Los Angeles, Cal., until April 12, for furnishing hydraulic turbines for the Truckee-Carson project, Nevada. For further information address the above office, or the United States Reclamation Service, Department of the Interior, Washington, D. C. F. H. Newell is director.

SOMERSWORTH, N. H.—A bill has been passed by the State Legislature giving the town of Somersworth the right to establish and maintain a municipal electric light plant. The present pumping station was designed with a view of installing an electric plant. The Twin State Gas & Electric Company, of Dover, N. H., now furnishes electrical service and has the contract for street lighting, which will not expire for two years.

KENILWORTH, N. J.—The Papyrus Artificial Paper Company, of Hoboken, N. J., is reported to be erecting a factory building, 50 ft. x 150 ft., two stories high, at Kenilworth, N. J. As soon as the building is completed the company will remove its manufacturing plant in Hoboken to Kenilworth. Other buildings will be erected as needed. Power for operating the plant will be purchased from the Public Service Corporation of New Jersey.

VINCENTOWN, N. J.—It is reported that the Water Company is considering a proposition to install a generator to supply electricity for lighting the town.

NEW YORK, N. Y.—All bids received by the Department of Public Charities March 23 for furnishing material and construction of subway for conduit and electrical cables for lighting buildings and streets of the upper division of the New York City Home for Aged and Infirm, Blackwell's Island, have been rejected. Michael J. Drummond is commissioner.

NEW YORK, N. Y.—Bids will be received by John W. Brannan, president of the board of trustees of Bellevue and Allied Hospitals, Department New York City, 415 East Twenty-sixth Street, New York, N. Y., until April 11 for furnishing material and labor for the reconstruction of the electric light system at the Gouverneur Hospital, located at Gouverneur Slip, 621 Water Street, New York, N. Y. Blank forms may be obtained at the office of the contract clerk, 415 East Twenty-sixth Street, New York, N. Y.

UTICA, N. Y.—Bids will be received by the Board of School Commissioners, Utica, N. Y., until April 11, 1911, for combination gas and electric fixtures for the John E. Brandegee School. Dennis J. Kelly is clerk.

ANDREWS, N. C.—The City Council is contemplating issuing bonds to the amount of $20,000, the proceeds to be used for water-works, electric lighting and street improvements. H. N. Wells is Mayor.

CLEVELAND, OHIO.—The Cleveland, Alliance & Mahoning Valley Railroad Company has applied to the Secretary of State of Ohio for permission to increase its capital stock from $10,000 to $2,500,000. The company is planning to build an electric railway from Alliance to Ravenna, work on which has already begun.

CLEVELAND, OHIO.—The Standard Oil Company, it is stated, will erect a large can factory in Cleveland, consisting of two concrete buildings, 70 ft. x 300 ft., two stories high, and a boiler house, contract for which has been awarded to the Crowell & Sherman Company, of Cleveland, Ohio. It is understood that some power plant equipment will be required.

COLUMBUS, OHIO.—Proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until April 17 for furnishing two electric elevators and two electric dumbwaiters in the extension to the United States post office and court house, Columbus, Ohio, plans and specifications for which may be obtained at the above office. James Knox Taylor is Supervising Architect.

EAST LIVERPOOL, OHIO.—The capital stock of the East Liverpool Traction & Light Company has been increased from $10,000 to $1,300,000. It is stated that the Beaver County Light Company, which operates lighting systems in Beaver Falls, Rochester, Beaver, New Brighton and Ambridge, will be taken over by the new holding company. It is understood that it is proposed to operate all lighting and traction systems in the upper Ohio and Beaver Valley under one head. The company is contemplating the construction of a large electric plant either close to the Ohio-Pennsylvania State line or at the mouth of the Yellow Creek and the Ohio River.

BOSWELL, OKLA.—At an election held recently the citizens voted to issue bonds to the amount of $35,000, the proceeds to be used for the installation of an electric light plant and water works system.

VIAN, OKLA.—At an election to be held soon the proposition to grant an electric light franchise and to issue bonds to the amount of $20,000, the proceeds to be used for the construction of a water-works system, will be submitted to a vote.

MILWAUKEE, ORE.—The Mount Hood Electric Company is reported to have purchased a site in South Milwaukee, on which it proposes to erect a power station for the distribution of electricity from the transmission line running through Milwaukee.

PORTLAND, ORE.—Plans are being prepared by the Portland Railway, Light & Power Company for extensive developments to its properties during the next two years, which will involve an expenditure of about $4,000,000 and will place the company by 1914 in a position to supply electricity in a large district in Oregon and Washington. With construction work now under way together with work laid out for the next two years the company will be able to generate 100,000 hp by its hydroelectric plans. This includes the 15,000-hp plant at Oregon City, 25,000 hp at the Cazadero plant, 25,000 hp at Estacada plant, which will be completed in September, and 40,000 hp additional to be developed at the plant on the Upper Clackmas River.

PORTLAND, ORE.—The Portland Power & Light Company, which has recently purchased the property of the Hood River Light, Power & Water Company, of Hood River, Ore., and the Husum Power Company, at White Salmon, Wash., is contemplating extensive improvements and extensions, which will involve an expenditure of about $1,000,000, and include the construction of a transmission system for the distribution of electricity along the Columbia River for 250 miles. The output of the Hood River plant will be increased from 2500 hp to 3000 hp and the White Salmon plant will be enlarged. A cable will be extended across the Columbia River connecting the two properties. Orders have been placed for material for a high-tension line between Hood River and The Dalles, thereby connecting Hood River, Mosier, White Salmon and The Dalles in one circuit. Surveys have been started and a high-tension line will be erected this summer from The Dalles to Umatilla, a distance of 121 miles. This line will cross the Columbia to Luzon and extend up the Columbia to Kennewick, where it will meet the new transmission line just completed from Walla Walla to Kennewick, and from there extended to Priest Rapids, thus connecting all the properties of the company. Electricity will be supplied for lamps, motors and irrigation purposes.

SALEM, ORE.—Plans are being made by the Oregon Electric Railway Company to begin construction of its extension south from Salem to Eugene, work on which will begin, it is said, as soon as the route is decided upon.

SPRINGFIELD, ORE.—It is reported that the City Council has appointed a committee to secure the cost of erecting a sub-station in Springfield with a view of establishing a municipal plant to furnish electricity for street lighting.

PANAMA.—Sealed proposals will be received at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until May 27 for furnishing miter gate-moving machines, miter forcing machines and electric motors for same, for the lock gates. Blanks and general information relating to this circular (No. 627) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, New Orleans, La.

PANAMA.—A new 500-kw, 2200-volt, three-phase, 25-cycle turbo-generator set is to be installed in the electric generating and air-compressor plant near East Balboa, replacing the present electrical generating equipment. The plant has been supplying alternating current for lamps in Ancon, Balboa and East Balboa, and direct current for operating cranes on the Panama Railroad wharf and for motors in the Pacific Division machine shop. These motors will be superseded by alternating-current machines when the new equipment is put into operation. Under the new arrangement the Balboa and Miraflores plants will be operated in parallel, the former carrying the day load and the latter the night load. The committee has recommended that the present circulating-water system be retained for the condenser at the Balboa plant, but that a centrifugal pump driven by an electric motor be substituted for the circulating pump now in use.

BUTLER, PA.—The capital stock of the Butler Light, Heat & Motor Company has been increased from $50,000 to $200,000.

JOHNSTOWN, PA.—The Johnstown Passenger Railway Company is reported to be contemplating extending its railway to Geistown, for which, it is said, rights of way have been secured.

LOCK HAVEN, PA.—The Lock Haven & Jersey Shore Railroad Company is now locating the route for its proposed electric railway to connect Lock Haven and Woolrich, a distance of twelve miles. The power station will be located in North Fork, Pa. L. M. Patterson, of Lock Haven, Pa., is president.

PITTSBURGH, PA.—The Independent Developing Company, recently incorporated, proposes to build urban and interurban electric railways between Duquesne and Glassport and also to take over the property of the Duquesne & Dravosburg Street Railway Company and the Duquesne Annex Land Company. The plans include the construction of three miles of track to connect Duquesne Annex and Dravosburg, work on which will begin at once. It is expected that the railway will be extended to Glassport.

CHARLESTON, S. C.—The stockholders of the Charleston Consolidated Railway & Lighting Company have voted to increase the capital stock of the company from $2,000,000 to $3,000,000, the proceeds to be

used to pay for additions now being made to the system and to provide for future improvements and extensions. Philip H. Gadsden, of Charleston, S. C., is president of the company.

VERMILION, S. D.—The City of Vermilion has engaged the W. K. Palmer Company Engineers, Dwight Building, Kansas City, Mo., to take charge of the engineering work in connection with the construction of a municipal electric light plant and remodeling the water-works system, which is to be taken over by the city.

CHATTANOOGA, TENN.—The sawmill of the McLean Lumber Company, of Chattanooga, Tenn., was destroyed by fire on March 22, causing a loss of about $60,000. Practically all of the machinery, including power plant, will have to be replaced.

NASHVILLE, TENN.—Preparations are being made to extend the new street lighting system in the downtown section, taking in the viaducts and the Woodland Street bridge. A contract has been awarded to the Union Metal Company, of Canton, Ohio, for fifty lamp standards for same. J. W. Pentecost, superintendent of the city light department, will have charge of the work.

ALTO, TEX.—A site on which to erect an electric light and ice plant has been donated to L. S. Atkins, of Center, Tex. It is expected to have the plant in operation within sixty days.

BROWNSVILLE, TEX.—The Brownsville & Gulf Railway Company has applied to the City Council for a franchise to operate motor cars over its line. The company is planning to reconstruct its road and establish a regular passenger service through the city and across the international bridge over the Rio Grande to Matamoras, Mex. The franchise includes a request to operate the cars by electricity, and it is understood that the railway will be equipped for electrical operation later on. The railway is owned by the St. Louis, Brownsville & Mexico Railroad Company, with which it connects.

CHAPIN, TEX.—Investigations have been made by D. B. Chapin, of Chapin, along the Devil's River, in western Texas, with a view of building one or more dams across the canyon for the purpose of utilizing the water to reclaim the land in that section by irrigation. It is proposed to construct a large canal system and install pumping plants.

FORT WORTH, TEX.—The Northern Texas Traction Company has secured the right of way for its proposed interurban electric railway to extend from Fort Worth to Cleburne, a distance of twenty-eight miles. The Stone & Webster Management Association has charge of the system.

HILLSBORO, TEX.—The Board of Trade has taken up the question of promoting the construction of an interurban electric railway between Dallas and Hillsboro. The extension of the electric railway, which is to be built from Dallas to Waxahachie, to Hillsboro is reported to be under consideration.

HOUSTON, TEX.—The contract for the electrical installations in the administration building, the mechanical laboratory and power plant for the William E. Rice Institute has been awarded to the Newberry Electric Company, of St. Louis, Mo., for $18,960.

HOUSTON, TEX.—Plans are under way for the construction of an electric railway from Houston to the turning basin in Buffalo Bayou, for which rights of way are now being secured. For further information address Harvey T. D. Wilson, of Houston, Tex.

HOUSTON, TEX.—Plans are being made by the San Leon Terminal Railroad Company for the construction of an interurban railway to extend from the Bay front at the suburb of San Leon to Dickinson, where it will connect with the Houston-Galveston Interurban Railway. The proposed road will be eight miles long, and it is understood that the contract for construction of the first three and one-half miles will be awarded before April 15. Gasoline motor cars will be operated temporarily; it is proposed to equip the railway for electrical operation the early part of next year.

LULING, TEX.—The City Council has granted the Luling Electric Light & Power Company a franchise to erect and maintain an electric plant in Luling for a term of twenty years.

SAN ANTONIO, TEX.—It is reported that preliminary plans have been prepared by F. S. Pearson, of New York, N. Y., and associates for the development of a large hydraulic and irrigation project in the southwestern part of Texas. It is said that options have been secured on several hundred thousand acres of land in the valleys of the Medina and Nueces Rivers and surveys made for a series of dams and hydroelectric plants. The initial plans call for an expenditure of about $5,000,000. C. H. Carney, manager and chief engineer of the Mexico Light & Power Company, Mexico City, is said to be in charge of the Texas enterprise.

WEATHERFORD, TEX.—It is reported that J. R. Deddinger, of Dallas, Tex., has purchased the plant and holdings of the Home Telephone Company in Weatherford. It is understood that the consideration was $98,600.

OGDEN, UTAH.—Surveys have been made and estimates prepared by W. M. Bostaph, city engineer, for the construction of a large reservoir in the South Fork Canyon, to cost about $350,000. It is proposed to erect a dam either in Magpie Canyon or Cobble Creek Canyon, both locations being owned by the City of Ogden. The water will be utilized to operate an electric plant to supply electricity for the City of Ogden and to supply water for irrigation purposes and also for domestic purposes in Ogden. The cost of the entire project that the promoters have in view is approximately $842,418, but the initial development will involve an expenditure of only $350,000.

RADFORD, VA.—The Virginia Power Company, recently incorporated, has purchased the plant and holdings of the Radford Water Power Company, which operates the electric light, street car and water-works systems in Radford. The consideration is said to be $200,000. The Virginia company has acquired water rights on the New River and on North Carolina streams. The first development, it is understood, will be at Ingles Ferry. The local plant will retain the same management for the present. Dr. J. V. Mott is president of the Virginia Power Company, and A. Bird is general superintendent of the Radford Water Power Company.

KELSO, WASH.—The City Council has granted the Washington-Oregon Corporation franchises to supply both water and light in Kelso for a term of fifty years. Under the terms of the franchise the company is to supply one arc lamp free of charge for every 400 in population; a reduction is also made in the rates for electricity for lamps. The city is granted the privilege of readjusting rates every five years under the lighting franchise.

NORTH YAKIMA, WASH.—The Business Men's Association is reported to have asked the Pacific Power & Light Company to submit estimates of cost for installing cluster lamps on Yakima Avenue.

PLEASANT VALLEY, WASH.—A temporary organization has been formed by a number of ranchers with a view of organizing a co-operative company for the purpose of building a power plant on Quillisasent Creek to furnish electricity for lamps and motors to the residents of Pleasant Valley. It is proposed to erect a small generating plant at the head of the creek, and to use the water after passing through the power plant for irrigating purposes.

PORT ORCHARD, WASH.—Plans are being prepared by J. W. Bullard, of Tacoma, architect, for the construction of a new hospital building to cost $65,000, and a power house, at $35,000, for the Veterans' Home in Port Orchard, Wash.

SEATTLE, WASH.—The contract for installing cluster lamps on Third Avenue, subdivision No. 1, has been awarded to R. E. Downie, of Seattle, Wash.

SUMAS, WASH.—The Western Canada Power Company is reported to be contemplating establishing a power plant and sub-station in Sumas, to cost approximately $100,000.

WHITE SALMON, WASH.—The property of the Husum Power Company has been purchased by the Pacific Power & Light Company, of Portland, Ore., which operates plants at Hood River, Walla Walla, The Dalles and North Yakima. It is understood that plans for the construction of a concrete dam to increase the output of the plant will be carried out.

BARABOO, WIS.—The City of Baraboo has applied to the Wisconsin Railway Commission for authority to establish and operate a municipal electric light plant. The Baraboo Lighting Company furnishes electrical service in the city at present.

BAYFIELD, WIS.—Preparations are being made by the Water and Light Commissioners for improvements to the electric light plant, work on which will begin in the near future.

FOND DU LAC, WIS.—The Wisconsin Railway Commission has authorized the Eastern Wisconsin Railway & Lighting Company, of Fond du Lac, to issue $76,000 in bonds, the proceeds to be used to pay outstanding indebtedness incurred for additions and extensions and improvements to its system.

HUDSON, WIS.—The Burkhardt Milling & Electric Power Company, which supplies electrical service in Hudson, Burkhardt and North Hudson, has applied to the Wisconsin Railway Commission for authority to abolish its present meter rental of 25 cents per month and to substitute therefore a minimum rate, the amount of which is left to the commission to decide.

MILWAUKEE, WIS.—A number of business men on National Avenue have decided to take steps to secure a uniform system of street lamps in that section of the city.

MILWAUKEE, WIS.—The Wisconsin Railway Commission has authorized the Milwaukee Northern Electric Railway Company to issue $1,500,000 bonds to be secured under a mortgage executed by the company to the First Savings & Trust Company, of Milwaukee, Wis. The bonds are to be issued for money only and for not less than 75 per cent of par value. The company has also been granted permission to issue $1,000,000 in capital stock, to be sold for money only and at not less than par, the proceeds to be used to purchase and retire an outstanding indebtedness of $2,500,000.

SHARON, WIS.—The proposition to issue $7,000 in bonds, the proceeds to be used to install an electric light plant, will be submitted to the voters at the spring election.

SUN PRAIRIE, WIS.—The village of Sun Prairie, which recently acquired the property of the Sun Prairie Electric Light Company, by the exercise of its option to purchase, granted by the public utilities law, has requested the Wisconsin Railway Commission to investigate conditions in Sun Prairie and to recommend a schedule of rates for electricity for lamps and motors.

NEW WESTMINSTER, B. C., CAN.—At the annual meeting of the Okanagan Telephone Company to be held April 7 the proposition to

increase the capital stock by $450,000 will be voted upon. The question of moving the headquarters of the company from Vernon, B. C., to New Westminster will also be voted upon. The company is contemplating large extensions to its system.

BRANDON, MAN., CAN.—After considering several propositions for the construction of an electric street railway the City Council has instructed the city engineer to prepare plans for a municipal system.

WINNIPEG, MAN., CAN.—Bids will be received by M. Peterson, secretary Board of Civic Control, until May 1 for furnishing a number of ornamental lamp standards. For further information address F. E. Cambridge, city electrician.

WINNIPEG, MAN., CAN.—Bids will be received by M. Peterson, secretary Civic Board of Control, until April 27 for furnishing and installing electrical switching equipment complete for substation No. 1 on King Street, Winnipeg, Man. Plans and specifications may be obtained at the office of Smith, Kerry & Chace, engineers, Carnegie Library, Winnipeg.

CHATHAM, ONT., CAN.—The Windsor, Wallaceburg & Lake Erie Railway Company is reported to be contemplating extending its interurban railway to London, work on which will begin in the near future.

SANDWICH, ONT., CAN.—Mayor Breault has been authorized by the municipality to communicate with the Hydroelectric Power Commission of Ontario to secure the estimates of the cost of Niagara power to be supplied by the transmission system of the commission.

SANDWICH, ONT., CAN.—The Town Council is considering the question of granting a franchise to Robert Stuart, of Detroit, Mich., electrical engineer, for the construction of a transmission line from the old Mineral Springs property, through Sandwich, to supply electricity in the towns of Essex, Leamington and Kingsville. The company represented by Mr. Stuart already supplies electrical service in three towns in Essex County. It is proposed to abandon the small plants and establish a large central generating station, with transmission lines radiating throughout the county, supplying electricity to the farmers along the route of its transmission line.

TORONTO, ONT., CAN.—Bids will be received until April 11 (extension of time) for wiring exhibition buildings. G. R. Geary is Mayor.

TORONTO, ONT., CAN.—The Toronto Electric Light Company has applied to the City Council for a franchise to lay underground wires on several streets in this city.

WHITBY, ONT., CAN.—The Seymour Power Company, of Campbellford, Ont., it is reported, is contemplating extending its transmission line from Oshawa to Whitby. A by-law granting the company a thirty-year franchise in Whitby, will soon be voted upon. If the franchise is granted it is expected to have the system in operation by next June.

MONTREAL, QUE., CAN.—The Montreal Light, Heat & Power Company has awarded a contract for installing underground conduits to G. M. Gest, of Montreal, Que., for $100,000.

MOOSEJAW, SASK., CAN.—Bids will be received until April 10 for the construction of car barns and power house for the Moosejaw Electric Street Railway Company. R. G. Bunyard is architect.

REGINA, SASK., CAN.—According to a report submitted in the Provincial Parliament the Saskatchewan government has expended $1,600,000 in the construction of 1753 miles of long-distance telephone lines, in addition to 3490 miles of rural lines erected by the government-controlled companies. About $500,000 will be expended by the government on the erection of long-distance lines this year.

PUEBLA, MEX.—Preparations are being made for the construction of a large hydroelectric plant at Tuxpango Falls, at Tuxpango, by the Puebla Light & Power Company, work on which will begin as soon as surveys have been completed and plans prepared. The proposed project calls for an expenditure of about $6,000,000 and includes the erection of transmissino lines to Puebla and other cities and towns in this section.

New Industrial Companies.

THE AMERICAN INSULATING COMPANY, of Alexandria, Ind., has been incorporated with a capital stock of $600,000. The company will take over the property of the American Insulating Material Manufacturing Company. The directors are: M. F. and J. L. Sawyer, G. B. Slaymeker, F. M. White, C. L. Bayne and J. H. Boogher.

THE BROWN ENGINEERING & EQUIPMENT COMPANY has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $25,000, and the incorporators are: J. W. Brown, of Bellevue, Pa.; W. J. Storey and A. E. Duckham, of Pittsburgh, Pa.

THE CANTON MANUFACTURING COMPANY, of New York, N. Y., has been chartered with a capital stock of $150,000 by C. Kriser, of Brooklyn, N. Y.; S. L. Baron and A. A. Canton, of New York, N. Y. The company proposes to manufacture motors, engines, machinery, etc.

THE CLARK ELECTRICAL PURIFIER COMPANY, of Los Angeles, Cal., has been incorporated with a capital stock of $25,000 by D. A. Warren, C. W. Clark and C. C. Davis.

THE CULVER-STEARNS MANUFACTURING COMPANY, of Worcester, Mass., has been incorporated with a capital stock of $10,000 by Fred A. Culver, Jason C. Stearns and Edgar A. Dalrymple. The company proposes to manufacture electrical devices.

THE DELEVAN MOTORS COMPANY, of Wilmington, Del., has been incorporated with a capital stock of $150,000. The incorporators are: G. G. Stiegle, R. G. Lupton and H. W. Nock, of Wilmington, Del.

THE LEE'S RAILWAY SWITCH DEVICE COMPANY, of San Diego, Cal., has been incorporated with a capital stock of $500,000 by T. E. Lee, J. W. Hastain, J. C. Hocker, C. F. Mohnike, W. A. Browne, D. S. Miller and W. V. O'Farrell.

THE C. J. OLSEN MANUFACTURING COMPANY, of Pittsboro, Ind., has been incorporated by C. J. Olsen, W. F. Hiatt and C. A. Weaver. The company proposes to manufacture combined insulators and lightning arresters and sanitary window sash.

THE SEMI-DRY BATTERY COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 by J. G. Hamner, Jr., A. G. Hubbell and W. H. Wooley, of New York, N. Y. The company proposes to deal in electrical apparatus and supplies and to do all kinds of electrical work.

THE SOUTHERN EQUIPMENT & SUPPLY COMPANY has been organized for the purpose of assisting in the development of the Bedford (Ind.) stone industry. It will handle general construction work with particular attention to electrical construction and maintenance and the application of electrical drive to quarrying and mill machinery. A complete line of quarry and mill supplies, both electrical and mechanical, will also be carried.

THE SWANSTROM MANUFACTURING COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $50,000 by G. E. Q. Johnson, J. A. Johnson and L. D. Swanstrom, of Chicago, Ill. The company proposes to manufacture engines and motors.

THE UNIQUE FAN COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $50,000 by M. A. Carmody, W. A. Grece and J. M. McIlravey, of Jersey City, N. J. The company proposes to manufacture revolving and tilted fans, etc.

THE VACUUM ENGINE MANUFACTURING COMPANY, of Chicago, Ill., has been chartered by R. T. Roadhouse, G. W. Hiltabrand and F. Benjamin, of Chicago, Ill. The company is capitalized at $25,000 and proposes to manufacture machinery.

THE WILMINGTON MOTOR SERVICE COMPANY, of Wilmington, Del., has filed articles of incorporation with a capital stock of $30,000. The incorporators are: C. W. Bush, H. R. Isaacs and A. Finger, of Wilmington, Del.

New Incorporations.

LITTLE ROCK, ARK.—The Arkansas Kerasolar Light & Fuel Company has been granted a charter with a capital stock of $40,000. The incorporators are: A. Danville, J. L. Richardson and James W. Hall.

MARMADUKE, ARK.—The Marmaduke Telephone Company has been chartered with a capital stock of $10,000 and the following named officers: Wilder Carpenter, president; J. S. Simpson, vice-president, and W. E. Lynch, secretary and treasurer.

MARTINEZ, CAL.—The Bay Point Light & Water Company has been incorporated with a capital stock of $25,000 by Scott Hendricks, G. S. Arnold, Grant Smith, F. A. Warren and A. E. Fisher, of San Francisco, Cal.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Oro Electric Corporation with a capital stock of $10,000,000 by F. V. Berry, F. S. McAllister, W. B. Phelps, W. S. Wilsey, A. Harvey, E. Buckholz and W. G. Jack.

VISALIA, CAL.—Articles of incorporation have been filed for the Alpaugh Telephone & Telegraph Company with a capital stock of $25,000 by N. L. Wilson, T. G. Adams, C. E. Timmons, W. F. McFarland and M. G. McNeely.

TWINS FALLS, IDAHO.—The Garnett Irrigation & Power Company has filed articles of incorporation with a capital stock of $10,000,000. The company proposes to build a dam 90 ft. high across Snake River, at Garnet, below Mountain Home, at a cost of about $5,000,000. The incorporators are: B. G. Jaynes, of New York, N. Y.; F. Johnstone, of Iowa, and E. J. Dockey, of Boise.

FARMINGTON, ILL.—The Farmington Light & Power Company has been chartered with a capital stock of $30,000 to construct and operate an electric light plant in Farmington. The incorporators are: A. L. Thompson, Theodore Bass, M. M. Anderson and H. E. Worden.

PEORIA, ILL.—Articles of incorporation have been filed with the Secretary of State for the Milwaukee, Peoria & St. Louis Railway Company by Eugene C. Morton, Frank B. Reed, Frederick C. Vehmeyer, John O'Neill and Frank H. Gardiner, all of Chicago, Ill. The company proposes to build an electric railroad direct from Milwaukee, Wis., to St. Louis, Mo., via Rockford and Peoria, Ill. The first link is to be built between Peoria and Rockford, for which, it is understood, bids have been called and contracts will soon be awarded.

ROCKFORD, ILL.—The Rockford City Traction Company has been incorporated by A. A. Anderson, Warren Partridge and P. B. Warren, of Springfield, Ill. The company is capitalized at $2,000,000.

GENEVA, IND.—The Star Telephone Company has been incorporated with a capitalization of $1,200 to erect and operate a telephone system in Geneva and throughout Jefferson Township. Bartley Burk is president and Jesse C. Buckmaster is secretary of the company.

INDIANAPOLIS, IND.—Articles of incorporation have been filed for the Northern Indiana Gas & Electric Company with a capital stock of $5,000,000. The new company is a consolidation of the South Bend & Mishawaka Gas Company, the Michigan City Gas & Electric Company, the South Shore & Electric Company, the Indiana Harbor & East Chicago Electric Company, the Plymouth Light Company and the Whiting Electric Company. G. M. Geist is president and G. W. Curran secretary of the company.

VINCENNES, IND.—The Vincennes-Interstate Traction Company has applied for a charter to build urban and interurban railways in Indiana. The company is capitalized at $10,000. The directors are: J. L. Keymeyer, C. A. Benhain, C. E. Seeds, H. M. Lukens, C. W. Battin, A. W. Funkhouser and A. F. Funkhouser.

VINCENNES, IND.—The Vincennes Southeastern Interurban Railway Company has been incorporated with a capital stock of $50,000 to construct and operate electric street and interurban railways and power plants in the State of Indiana. The incorporators are: George B. Hazleton, Ray Eubank Roger and O. M. Lewis. It is understood that the company proposes to build an electric railway from Vincennes to Jasper.

HENDERSON, KY.—The Henderson Interurban Company has been incorporated with a capital stock of $100,000 by W. W. Cooper, of Smith Mills; E. F. Wheaton, of Nashville, Tenn.; C. E. Sugg, N. P. Taylor, J. W. Henson, Albert Leiber and others, of Henderson, Ky. The company proposes to build an electric railway from Henderson to Owensboro, about eighty-five miles in length.

NEWPORT, KY.—Articles of incorporation have been filed for the Northern Kentucky Street Railway Company with a capital stock of $10,000 by J. M. Dawson, Edward F. Kelly and Gwynne Dennis.

NEW ORLEANS, LA.—The Louisiana Company has applied for a charter to build and operate electric and steam railways in Louisiana. The first line to be built will extend from New Iberia to Berwick Bay, via Jeanerette, Franklin and Patterson. The capital stock is placed at $1,000,000. The officers are: George W. Dallas, president; John R. Taylor, vice-president, and V. J. Smith, secretary and treasurer.

DULUTH, MINN.—The Virginia, Eveleth & Gilbert Traction Company has filed articles of incorporation with a capital stock of $200,000. The incorporators are: W. M. Prindle, E. B. Merrill and G. T. Eagling.

WYLIE, MINN.—The Wylie Farmers' Telephone Company has been incorporated with a capital stock of $10,000 by Leon Huot, Frederick Gotham, of Red Lake Falls, and Regis Huot, of Wylie, Minn.

RED CLOUD, NEB.—The East Garfield Telephone Company has been incorporated with a capital stock of $10,000 by A. W. Shipman, T. H. Hawkins and Henry Emerton.

CHARLOTTE, N. C.—Negotiations have been practically completed whereby the City of Charlotte will purchase the water-works plant in the Dilworth section from the Charlotte Electric Street Railway Company, the plant having been bought by the interests allied with the Southern Power Company with the street railways systems about the first of the year. The consideration is said to be about $20,000.

GUILFORD COLLEGE, N. C.—The Guilford Telephone Company has been incorporated with a capital stock of $6,000 to construct and operate a telephone system in Guilford County. The incorporators are: D. W. Lindley, Lee S. Smith and others.

RALEIGH, N. C.—The Yadkin River Power Company, of Raleigh, N. C., has been chartered with a capital stock of $40,000,000 for the purpose of taking over the Blewitt Falls hydroelectric power plant in Richmond County. The company proposes to complete the plant and supply electricity for the operation of public utilities and for interurban railways. Charles E. Johnson, of Raleigh, N. C., is president, and E. Clifford Potter, of Boston, Mass., treasurer.

SALISBURY, N. C.—The Virginia Power Company has been organized with a capital stock of $1,000,000 for the purpose of developing a hydroelectric power project, the principal one to be located on the New River in Virginia. J. J. Mott, of Statesville, N. C., is interested.

WHITE EARTH, N. D.—Articles of incorporation have been filed for the White Earth Lighting Company with a capital stock of $10,000 by O. M. Muss, Cornelius Hansen, Peter Herseth and A. B. Feiring, all of White Earth, N. D.

BROWNSVILLE, OHIO.—Articles of incorporation have been filed for the Brownsville Telephone Company with a capital stock of $10,000 by John A. Mack and others.

CINCINNATI, OHIO.—The Logan Electric Company has filed articles of incorporation with a capital stock of $25,000 for the purpose of erecting and operating power plants. The incorporators are: W. F. Bevill, Charles Bennett, S. M. Bisan, Naman Jackson and Frank R. Hurst, all of Logan.

STEUBENVILLE, OHIO.—The Steubenville, Wellsburg & Weirton Railroad Company has been incorporated by Frank D. Sinclair, Michael Keane, J. E. Wheaton and Nelson D. Miller, all of Steubenville, Ohio. The company is capitalized at $10,000 and proposes to build a street car line from the east end of Market Street bridge to Weirton. The company is a subsidiary of the Tri-State Railway & Electric Company.

MOUNTAIN VIEW, OKLA.—The Fairview Telephone Company has been chartered with a capital stock of $5,315 by R. L. Hadley, T. A. Cook and A. E. Carsten.

MUSKOGEE, OKLA.—The People's Electric Railway Company has been chartered by W. M. Patterson, Samuel Spaulding, J. M. McDonald, W. R. Robison, T. H. Martin and J. H. Huckleberry, all of Muskogee, and G. W. Risser, of Oklahoma City.

PITTSBURGH, PA.—The Pittsburgh, Butler, Slippery Rock, Grove City & Northern Street Railway Company has been chartered with a capital stock of $156,000. The directors are: Charles Gibson, Jr., of Pittsburgh, Pa., president; William M. Galbraith, of Pittsburgh, Pa.; W. C. McCandless, John Trautman, of Butler, Pa.; F. L. Forrester and John C. Kerr, of Slippery Rock, Pa.

Personal.

MR. A. G. SANGSTER, Vancouver, B. C., has been appointed electrical superintendent for the City of Saskatoon, Sask., succeeding E. L. White.

MR. N. J. FOSTER has retired from the Fairbury Electric Light Company, Fairbury, Ill., and H. A. Foster and W. B. Decker are now in full control.

MR. CLYDE PADDEN, of New Hampton, Ia., has been made a manager for the Padden Gas & Electric Manufacturing Company, of New Hampton, Ia.

MR. WILLIAM P. SIDLEY, of Chicago, vice-president of the Western Electric Company, has been elected president of the Union League Club, of Chicago.

DR. C. P. STEINMETZ will be the chief guest and speaker at a meeting of the Washington Section of the American Institute of Electrical Engineers to be held at the Cosmos Club on April 11.

MR. W. D. WEAVER, editor of the *Electrical World*, sailed on the steamship *Mauretania* on April 5 for a short visit to Paris, where his address will be, until May 1, 65 rue des Saints-Pères.

MR. FRANK G. SPRAGUE, of New York City, will address the Electrical Engineering Society of Massachusetts Institute of Technology, Boston, Mass., on April 12. Mr. Sprague will discuss some pertinent engineering topic.

MR. J. A. TRAWICK, who has been with the Tampa (Fla.) Electric Company since 1907, will resign as its general manager in May to become general manager of the Mississippi River Power Company with headquarters at Keokuk, Ia.

DR. ROBERT BOSCH, of Stuttgart, Germany, designer and inventor of the magneto-generator system of ignition with which his name is associated, is in this country visiting some of the larger American industries in company with Mr. Otto Heins, president of the Bosch Magneto Company, of New York.

MR. JOHN H. BARKER has been appointed manager of the New York office of the Diehl Manufacturing Company, 90 Prince Street. Mr. Barker has been salesman of the special apparatus department and for several years previous was manager of the New York office of the Northern Electric Manufacturing Company.

MR. N. A. KEMMISH has resigned as electrical engineer of the Lincoln (Neb.) Traction Company to become general manager of the municipal electric lighting and pumping station at Alliance, Neb. Mr. Kemmish, who has been with the Lincoln Traction Company for the past seven years, is a graduate of the University of Nebraska.

MR. C. E. ROESCH, JR., for several years connected with the power department of the Fort Wayne Electric Works at the home office, has been transferred to become a member of the selling organization in the Chicago office of the company. His fellow-employees in Fort Wayne gave him a farewell banquet at the Commercial Club before his departure for Chicago.

MR. MARQUIS D. CRAIN, night chief operator for the Western Union Telegraph Company in St. Louis, died on March 26, aged seventy years. "Colonel" Crain, as he was widely known, was a field telegrapher with the Union troops during the Civil War, serving under Andrew Carnegie and Col. R. C. Clowry. He is survived by a wife and eight adult children.

MR. ALBERT CAVALLO JEWETT, of the foreign department of the General Electric Company, is on a short visit to this country after a residence of some years in India. While in India Mr. Jewett was for three years electrical adviser to the government of Kashmir, and he will shortly sail for Cabul, Afghanistan, where he will act as chief engineer of a British firm in the installation of a large electrical plant.

MR. THOMAS H. YAWGER, superintendent of the Rochester Railway & Light Company, Rochester, N. Y., has returned from Europe, where he went three months ago in search of rest and recreation. Mr. Yawger has been connected with the Rochester company for many years and his recent trip abroad was the first extended leave from his strenuous duties in looking after the many generating stations and substations which his company possesses.

MR. FRANK W. SMITH, secretary of the United Electric Light & Power Company, New York City, was presented with a handsome diamond scarfpin and silver cigarette case and matchbox by the Association of Employees of the United Electric Light & Power Company at its recent beefsteak party. In years of service there are few men in the industry who surpass Mr. Smith, for he has been connected with the United company for thirty-one years, and the presentation was made as a fitting commemoration of the event.

MR. L. F. PAYNE, who has been commercial manager of the People's Water & Light Company, of Harrisburg, Ill., since Jan. 1, in charge of distribution and sales, has been made general manager of that company. Mr. G. Clinton Smith, formerly superintendent of production at Harrisburg, has gone to Iron River, Mich., to become superintendent of the Menominee Range, Power & Development Company. Both companies are under the general management of Mr. James R. Cravath, of Chicago.

MR. CHARLES L. EDGAR, president and general manager of the Edison Electric Illuminating Company of Boston, sailed from New York on the *George Washington* of the North German Lloyd Line on March 30 for a period of rest and recreation which will be enjoyed in an automobile tour through Europe. About two weeks each will be spent in driving through England, France, Italy and Germany. With Mr. Edgar are Mrs. Edgar, their son, Mr. Leavitt L. Edgar, Miss Margaret Clough and Miss Laura F. Duclos, together with a maid and chauffeur. All will return in the early summer.

MR. CARL RAYMOND GRAY has resigned as vice-president of the St. Louis & San Francisco Railroad Company to become president of the companies owning and operating the electric lines of the United Railways and the Oregon Electric Railway, Portland, Ore., and the steam lines of the Astoria & Columbia River Railroad, the Oregon Trunk Railway, the Pacific & Eastern Railway and the Spokane & Seattle Railway, with offices at Portland. Mr. Gray, who succeeds Mr. John F. Stevens in the presidency of the above road, has been connected with the St. Louis & San Francisco Railroad since 1882, when he began service as a telegraph operator.

Obituary.

MR. LOUIS A. LURIENNE, for fifteen years representative of the French Cable Company in the United States and Canada, died in Paris on March 25 after a lingering illness due to nervous prostration. He had gone to Europe to consult specialists. He was in his fifty-second year, and was an officer of the French Legion of Honor, vice-president of the French Chamber of Commerce in New York City, and an official of the French government telegraphs in France.

MR. GEORGE BOWERS CALDWELL, for many years connected with the engineering department of Westinghouse, Church, Kerr & Company, as one of the chief mechanical engineers, died March 31, 1911, at Yonkers, N. Y. Mr. Caldwell was born at Lawrence, Mass., in 1863. Prior to his connection with Westinghouse, Church, Kerr & Company, he was employed for thirteen years in the machine shops of the Lawrence Manufacturing Company, of Lowell, Mass., and the Washington Mills Company, of Lawrence, Mass., in charge of new construction and repair work. During his connection with Westinghouse, Church, Kerr & Company, which began in 1893, he was connected with the design and construction of the following important pieces of work: The mechanical and electrical features of the South Terminal Station, Boston, Mass.; the terminal station of the Pittsburgh & Lake Erie Railroad; the railroad shops of the P. & L. E. R. R., at McKee's Rocks; the construction of the Kingsbridge Power Station, New York City, for the Third Avenue Railroad. He also supervised the design and installation of the Long Island Railroad Company's electrification, including the large power house at Long Island City. His last work was in charge of design and construction of the mechanical and electrical features of the Pennsylvania Terminal Station in New York City, which he was obliged to relinquish just before it was completed. Mr. Caldwell leaves a wife, four children and his father, Lewis H. Caldwell, the latter being a resident of Los Angeles, Cal. The deceased was a member of the American Society of Mechanical Engineers and the American Society of Civil Engineers.

Trade Publications.

WIRES AND CABLES.—Detailed information relating to all types of wires and cables for electric installations is given in Catalog E of M. D. Austin & Company, Chicago, Ill.

ALTERNATORS.—Alternating-current generators arranged for direct connection with water turbines are described in detail in Bulletin No. 4799 of the General Electric Company.

ELECTRIC OVENS.—Various types of electric ovens are illustrated, listed and briefly described in a bulletin issued by the Despatch Manufacturing Company, Minneapolis, Minn.

AIR COMPRESSORS.—Bulletin No. 4025 of the Allis-Chalmers Company, Milwaukee, Wis., covers portable and stationary motor-driven air compressors for use in industrial establishments.

STEAM-ELECTRIC GENERATOR SETS.—Bulletin No. 411 of the Triumph Electric Company, Cincinnati, Ohio, is devoted to small directly connected generating sets intended for isolated-plant service.

ROCK DRILLS.—A good engineering description of electric rock drills is given in Bulletin No. 1120 of the Fort Wayne Electric Works, Fort Wayne, Ind., which has now reached its fourth edition.

OUTLET BOXES.—In its Bulletin D. the Steel City Electric Company, 1207 Washington Avenue, Pittsburgh, illustrates, describes and lists outlet boxes, which are furnished with the well-known knockout plugs.

TESTING SETS.—The Leeds & Northrup Company, Philadelphia, Pa., has issued Catalog No. 50, in which are illustrated and described the various types of cable-testing apparatus manufactured by the company.

INDUSTRIAL THERMOMETERS.—Bulletin No. 39 of the Industrial Instrument Company, Foxboro, Mass., deals with thermometers for industrial purposes covering a range of from 50 to 500 deg. Fahr.

INDUCTION MOTORS.—Polyphase induction motors rated at from 0.5 to 250 hp and for a frequency of 60 cycles are illustrated and described in Bulletin No. 126 of the Crocker-Wheeler Company, Ampere, N. J.

VENTILATING FANS.—Disk and propeller fan outfits driven by directly connected direct-current and alternating-current motors are described in Bulletin No. 235 of the Sprague Electric Company, of New York.

RAILWAY MOTORS.—Bulletin No. 4817 of the General Electric Company is devoted to commutating-pole railway motors rated at 75 hp, 600 volts. The weight of the motors complete with gear and gear case is 3800 lb.

BELTING.—Leather belting of the laminated type is described and its advantageous features discussed in a convincing manner in a booklet issued by the American Laminated Belting Company, 113 Hudson Street, New York.

TELEPHONE SWITCHBOARDS.—In its Pamphlet No. 33 the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., describes briefly its compact-type private-branch exchange telephone switchboard.

SMALL MOTORS.—Many suggestions concerning the applications of small motors are contained in Bulletin No. 1122 of the Fort Wayne Electric Works, Fort Wayne, Ind. The motors described include both single-phase and direct-current types.

INDUCTION MOTORS.—The Ideal Electric & Manufacturing Company, Mansfield, Ohio, has issued Bulletin No. 1031, in which the design details and operating characteristics of polyphase induction motors of the squirrel-cage type are fully covered.

PREPAYMENT WATT-HOUR METERS.—Single-phase prepayment watt-hour meters of the induction type are fully described in a well-written publication, designed as Bulletin No. 1123, issued by the Fort Wayne Electric Works, Fort Wayne, Ind.

CORLISS ENGINES.—Design details relating to horizontal Corliss engines are given in Catalog E of the Vilter Manufacturing Company, Milwaukee, Wis. This catalog contains also a list of customers operating Corliss engines built by the company, which occupies 24 pages of closely spaced matter.

SMALL TRANSFORMERS.—Transformers designed for use with electric bells are briefly described and illustrated in folder No. 4511 issued by the Fort Wayne Electric Works, Fort Wayne, Ind. Transformers for use in sign lighting with low voltage lamps are described in leaflet No. 4512 of the same firm.

ELECTRIC FANS.—Bulletin No. 1126 of the Fort Wayne Electric Works, Fort Wayne, Ind., is a well-prepared publication dealing with fans for the 1911 season. The types described include desk and wall fans, booth fans, oscillating fans, floor column and counter column fans, ceiling fans and window ventilating fans.

STEAM ENGINES.—Bulletin No. 22 of the Ridgway Dynamo & Engine Company, Ridgway, Pa., is an attractive publication relating to four-valve engines of the so-called non-releasing-gear Corliss type. These engines differ from the usual type of Corliss engine in that they are designed for operation at considerably higher speed.

DIRECT-CURRENT MOTORS.—Motors of the constant-speed, variable-speed and adjustable-speed direct-current types are briefly noted in a booklet issued by the Rochester Electric Motor Company, Rochester, N. Y. Many of the applications made of these motors are shown by the means of illustrations of industrial establishments.

SELECTIVE RINGING SYSTEMS.—The Western Electric Company has issued Bulletin No. 1016, showing by means of well-prepared diagrams the arrangements that may be employed with harmonic selective systems for party telephone lines. The various elements which make up the complete system are briefly described and listed.

INDUSTRIAL THERMOMETERS.—Bulletin No. 145 of the Bristol Company, Waterbury, Conn., relates to indicating thermometers of the so-called long-distance type. These thermometers are so arranged that the indicating mechanism can be mounted upon the wall at any convenient location to show the temperature at any desired point.

ELECTRIC FOUNTAINS.—Catalog No. 50 of F. W. Darlington, 50 North Twenty-third Street, Philadelphia, contains numerous illustrations relating to portable and semi-portable electric fountains. These fountains are automatic, being so arranged that the turning on of a switch starts the apparatus, which then continues in operation indefinitely.

INSULATORS.—Much valuable information concerning dimensional details and operating characteristics of high-tension line insulators is contained in a publication issued by the Locke Insulator Manufacturing Company, Victor, N. Y., known as the "Insulator Book." The book also contains descriptions of the tests to which insulators are subjected.

INDUCTION MOTORS.—Induction motors of the single-phase type, rated at from 0.05 hp to 0.5 hp, are described in Bulletin No. 3140 of the Emerson Electric Manufacturing Company, St. Louis. Back-gear type, single-phase induction motors, with countershafts, rated at from

0.33 hp to 0.50 hp, are described in Bulletin No. 3139 of the same company.

MAGNETO GENERATORS.—The Bosch Magneto Company, 223 West Forty-sixth Street, New York City, has issued in bulletin form a reprint of a paper presented by Otto Heims before the Society of Automobile Engineers on Jan. 11, 1911. This paper was entitled "Influence of Multipoint Ignition on the Efficiency and Output of Internal Combustion Engines."

SEWING MACHINE MOTORS.—The Emerson Electric Manufacturing Company, St. Louis, Mo., has issued Bulletin No. 3910 relating to direct-current and alternating-current motors, designed with particular reference to use with family sewing machines. Motors intended for use with factory sewing machines are described in Bulletin No. 3911 of the same company.

TEXTILE MOTORS.—The Westinghouse Electric & Manufacturing Company of Pittsburgh, Pa., has issued, as "Textile Motor Talk No. 12," a booklet comparing the development of the textile type induction motor to that of the automobile. It points out the fact that motor drive is doing in cotton machines what the vehicle motor and vehicle engine have done to the "horseless carriage."

SMALL DIRECT-CURRENT MOTORS.—A direct-current motor for driving light machinery, such as a player piano, advertising device, small lathe, sewing machine, etc., is described in Bulletin No. 109 of the Engineering Electric Manufacturing Company, Stamford, Conn. This motor is designed for operation at speeds up to 5000 r.p.m. It is stated that at 2500 r.p.m. its output is 0.05 hp.

THERMOMETER THERMOSTATS.—The Bristol Company, Waterbury, Conn., has issued Bulletin No. 129, in which are illustrated, described and listed thermometer-thermostats for temperatures up to 800 deg. Fahr. The thermometers are shown in two forms, one for the measurement of the temperature at the point where the instrument is installed and the other for the measurement of temperature at any distant point.

GROUND CONES.—Under the title "Some New Facts About Grounding," the Paragon Sellers Company, 60 Fifth Avenue, Chicago, distributes its Bulletin No. 2, giving some interesting facts about the Paragon ground cone. The pamphlet is devoted to a discussion of the use of ground cones in grounding general electrical installations, railway systems, as well as telephone and signaling circuits. Many instructive diagrams are included.

SWITCHBOARD PANELS.—Bulletin No. 4749, issued by the General Electric Company, will prove of interest to any one considering the purchase of alternating-current switchboard panels. The panels illustrated are of the sectionalized type, and each section has a separate catalogue number. The panels are in three sections, and the pages of the bulletin are sectionalized so that the user may have before him a picture of the complete panel desired, together with a full description of the equipment.

STORAGE BATTERIES.—Much information concerning storage batteries of the stationary type is given in Bulletin No. 34 of the Willard Storage Battery Company. The batteries described are designed particularly for use with railway signals, isolated plants, fire alarm, telephone and telegraph installations. The bulletin contains descriptions of the plate elements and price lists of each of the parts of the cell. Storage battery plates intended particularly for signal service are described in Bulletin No. 29 of the same company.

ELECTRIC FANS.—The General Electric Company is distributing Bulletin No. 4806, which is a neatly executed publication dealing with electric fans and small motors for domestic service. Fans for all services are fully described and illustrated. Among the newer features may be mentioned 8-in., 12-in. and 16-in. fans driven by motors possessing an improved form of induction winding, which eliminates the necessity of a centrifugal switch for the control of the starting winding. These motors contain no moving contacts, and are therefore extremely simple in construction.

RECORDING INSTRUMENTS.—The Bristol Company, Waterbury, Conn., has issued a series of bulletins relating to its numerous types of recording instruments. Bulletin No. 128 covers circular-chart recording thermometers designed for temperatures between 90 deg. and 500 deg. Fahr. Bulletin No. 135 covers recording shunt ammeters for all ranges of direct current. Bulletin No. 141 relates to recording pressure gages with circular charts, having a diameter of either 6 or 8 in. In its Bulletin No. 147 the Bristol Company describes a radii-averaging instrument for use with circular chart records. This instrument is particularly suitable for obtaining the average radius of records traced on circular charts having uniform gradations.

ELECTRICITY ON THE FARM.—The General Electric Company has issued Bulletin B3038, entitled "Electricity on the Farm." The bulletin is divided into brief chapters, each covering a specific use for electricity on the farm, the various descriptions of motor applications being accompanied by illustrations of electrically operated farm machinery in actual service. The section covering barn and field machinery includes description and illustrations of motor-operated hay hoist, ensilage cutter, thresher, grist-mill machinery, etc., while the chapter on electric drive for dairy apparatus shows the use of motor-driven vacuum pumps for the operation of vacuum-milking and cattle-cleaning outfits, motor-driven separators and churns. Other chapters deal with electrically operated refrigerating plants to meet the requirements of the average farm, the application of motor drive and auxiliary electrical devices in the farm workshop and the possibilities of electric haulage for farm products. Electric lighting for farm buildings and yards, together with the large number of labor-saving devices which can be readily operated from lighting circuits, are also described.

BUSINESS NOTES.

THE HEMMING MANUFACTURING COMPANY has moved its offices from New York, N. Y., to Garfield, N. J.

THE ELLIOTT COMPANY, manufacturer of steam specialties, has moved to its new Boston offices in the Oliver Building, corner of Milk and Oliver Streets.

THE WESTINGHOUSE TRACTION BRAKE COMPANY has moved its St. Louis office to Room No. 318, Security Building. The Southwestern manager of the company is Mr. E. L. Adreon.

THE ALBERT & J. M. ANDERSON MANUFACTURING COMPANY has moved its Chicago office to 105 South Dearborn Street instead of 105 Dearborn Street, as previously stated in our columns.

THE TRIUMPH ELECTRIC COMPANY.—The transformer department of the Triumph Electric Company, Cincinnati, has been placed in charge of Mr. R. F. Pier, who formerly held a similar position as foreman of the transformer department of the Canadian General Electric Company at Peterboro, Ontario.

THE W. K. PALMER COMPANY ENGINEERS.—The cities of Vermilion, S. D., and Anita, Iowa, have secured the services of the W. K. Palmer Company Engineers, Kansas City, Mo., in connection with the installation of electric lighting stations and distributing systems and remodeling of the water-works systems at both places.

THE NATIONAL INDIA RUBBER COMPANY.—A complete line of rubber-covered lamp hoods, wires and cables will hereafter be carried by the National India Rubber Company, Bristol, R. I., at its branch office, at No. 155 New Montgomery Street, San Francisco, Cal., which is in charge of Otis & Squires.

THE FEDERAL MINIATURE LAMP COMPANY.—General offices of the Federal Miniature Lamp Company have been opened at 812 Hippodrome Building, Cleveland. The president and general manager of the company is Mr. Walter R. Armstrong, who will receive the assistance of Mr. B. F. Whelan, formerly of the Buckeye Electric Company.

ESCHER WYSS & COMPANY, engineers of Zurich, Switzerland, have opened a Canadian office in the Lumsden Building, Toronto, in charge of their chief engineer, Mr. Heyendahl. The opening of this office has been rendered necessary by the increased development of the company's water-turbine business in Canada. Among the turbines built or on order are two 13,000-hp units for the Western Canada Power Company; one 10,000-hp turbine for the Shawinigan Water & Power Company, Montreal; eleven 5500-hp turbines for the Niagara Falls Power Company, Niagara Falls, and three 10,250-hp turbines for the Canadian Niagara Power Company, Montreal.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Geo. S. Emery, 11 N. Royal St., Mobile, Ala. Annual convention in November.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next semi-annual meeting, New York City, April 6, 7 and 8, 1911.

American Electro-Therapeutic Association. Secretary, Dr. J. Willard Travell, 27 East 11th St., New York. Next meeting at Philadelphia, Pa., Sept. 5, 6 and 7, 1911.

American Institute of Consulting Engineers. Secretary-Treasurer, Eugene W. Stern, 103 Park Ave., New York City. The Council meets the first Friday of every month.

American Institute of Electrical Engineers. Secretary, Ralph W Pope, Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Electric Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Electric Railway Engineering Association. Secretary, Norman Litchfield, Interborough Rapid Transit Company, New York.

American Electric Railway Association. Secretary, H. C. Donecker, Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E.

Cowles, Little Rock, Ark. Annual Convention, May 16, 17 and 18, 1911. at Little Rock, Ark.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, James Farrington, Steubenville, Ohio.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, 135 Adams St., Chicago. Next meeting, Boston, Mass., June, 1911.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary, J. Andreucetti, Chicago & Northwestern Railway, Chicago. Next annual meeting Chicago, November 6 to 10, 1911. Semi-annual meeting, Washington, 1911.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, N. T. Wilcox, Lowell, Mass.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, 220 King St., West, Toronto, Can.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Acting Secretary F. D. Morris, 323 Hagerman Building, Colorado Springs, Col.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA. Secretary, Harvey Robinson, 124 West 42d St., New York. Meetings, fourth Tuesday of each month.

ELECTRIC CLUB, CHICAGO. Secretary, F. S. Hickok, 824 Marquette Building, Chicago. Meets every Wednesday noon, 303 Wabash Ave.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York. Annual meeting at Buffalo, N. Y., June 20, 1911.

ELECTRIC TRADES ASSOCIATION OF PHILADELPHIA. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursday of each month.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo. Next meeting in Kansas City, Saturday, June 10, 1911.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 125 Michigan Ave., Chicago. Annual meeting, Chicago, January, each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

ELECTRICAL CREDIT ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of directors meets second Thursday of each month.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, Engineering Societies Building, 29 West 39th St., New York.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, C. H. Lembower, Reading, Pa.

FLORIDA ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, H. C. Adams, West Palm Beach, Fla. Next meeting, Jacksonville, Fla., April 4 and 5, 1911.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, P. S. Millar, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago. Annual convention, Chicago, 1911.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, L. H. Woods, 2355 Jerome Ave., New York.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, J. V. Zartman, Indianapolis, Ind. Annual meeting, August 23 and 24, 1911.

INTERNAL COMBUSTION ENGINE ASSOCIATION. Secretary, Chas. Kratch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex. Next meeting, St. Paul, Minn., 1911.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Dubuque, Ia. Next meeting, Davenport, Ia., April 19, 20 and 21, 1911.

IOWA STREET & INTERURBAN ASSOCIATION. Secreary, L. D. Mathes, Dubuque, Ia. Next meeting, Davenport, Ia., April, 1911.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Independence, Kan., Sept. 21 and 22, 1911.

MAINE ELECTRICAL ASSOCIATION. Secretary, Walter S. Hyman, Waterville, Maine.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, Herbert Silvester, Detroit, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, T. C. Gordon, Little Falls, Minn.

MISSISSIPPI ELECTRIC ASSOCIATION. Secretary, A. H. Jones, McComb City Light and Power Co., McComb City, Miss. Annual convention, Gulfport, Miss., June 20-21, 1911.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER ASSOCIATION. Secretary, N. J. Cunningham. Next meeting, St. Louis, April 13-15, 1911.

NATIONAL ARM, PIT & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Third convention, Pittsburg, June 6-8, 1911.

NATIONAL ELECTRIC CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Niagara Falls, July 19, 1911.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive Secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York. Annual convention, New York City, May 29-June 2, 1911.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NEW ENGLAND SECTION. Secretary-Treasurer, L. D. Gibbs, 39 Boylston Street, Boston, Mass.

NATIONAL ELECTRIC LIGHT ASSOCIATION, PENNSYLVANIA SECTION. Secretary-Treasurer, Van Dusen Rickert, Pottsville, Pa.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NEBRASKA SECTION. Secretary-Treasurer, S. J. Bell, David City, Neb.

NATIONAL ELECTRIC LIGHT ASSOCIATION, GEORGIA SECTION. Secretary-Treasurer, H. M. Corse, Columbus Railroad Company, Columbus, Ga.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn. Next meeting, New York, March, 1911.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 343 Marquette Bldg., Chicago.

NATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Joseph B. Ware, Grand Rapids, Mich.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, Frank McMaster, Beatrice, Neb.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, L. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 33 West 39th St., New York.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July 25-28, 1911.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. Next meeting at Youngstown, May 18 and 19, 1911.

ORDER OF REJUVENATED SONS OF JOVE. Mercury (Secretary), R. M. Van Vleet, 1157 Monadnock Building, Chicago, Ill.

PACIFIC COAST ELECTRIC VEHICLE ASSOCIATION. Secretary, A. H. Halloran, 604 Mission St., San Francisco, Cal.

PITTSBURGH ELECTRIC BOOSTER CLUB. Recording Wattmeter, O. R. Rombach, 919 Liberty Ave., Pittsburgh, Pa. Meetings, fourth Monday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. B. Moore, 39 Trinity Place, Boston. Monthly meeting, first Monday of each month.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, D. G. Fisher, 1316 Commerce St., Dallas, Tex. Annual convention, Houston, Tex., April 27-29, 1911.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, C. G. Reel, Kingston, N. Y. Annual meeting at Cooperstown, June 27 and 28, 1911.

UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1911.

VERMONT ELECTRICAL ASSOCIATION. Secretary, A. B. Marsden, Manchester Center, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 145 Monroe St., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

WIRELESS INSTITUTE. Secretary, Alfred N. Goldsmith, College of the City of New York, New York.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, John S. Allen, Lake Geneva, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 28, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City]

987,690. LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed April 11, 1907. Incandescent electric lamp socket carrying a plurality of lamps with axes in a common plane, including a shell carrying a socket with tubular stem secured to shell, one end forming a chamber, an insulating base in the chamber carrying binding screws and means extending through the stem for connecting the terminals with the socket contacts.

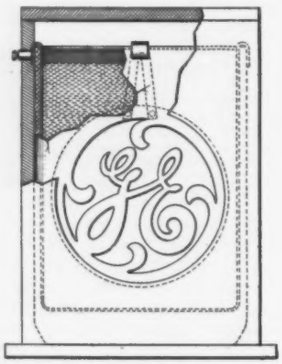
987,694. ELECTRIC HIGH WATER ALARM; E. E. Brackett, Central Falls, R. I. App. filed July 14, 1909. Ball float operates a lever switch which controls an electric circuit.

987,698. MULTIPLE VOLTAGE CONTROLLER; H. W. Cheney, Milwaukee, Wis. App. filed Oct. 5, 1908. Rheostat drum which is given a snap action and a non-snap action, the former when the motor armature connections are changed and the latter at other times with a blow-out magnet for blowing out the arc produced on interrupting the armature circuit, all said interruptions occurring at one fixed point.

987,717. ELECTROLYTIC CELL; T. Griswold, Jr., Midland, Mich. App. filed Dec. 7, 1907. Electrolysis of alkaline chlorids. Two solid non-porous carbon electrodes and an annular separating member between them whereby a chamber for the electrolyte is formed, the inner faces of the electrodes forming an anode and a cathode.

987,720. TELEGRAPHY; B. P. Hayes, Topeka, Kan. App. filed May 17, 1910. A line wire with jack contacts, a local circuit with a jack plug cutting into line, a direct connection from one side of the plug to the ground, a relay, a variable resistance, a key, a line from the other side of the plug to one relay contact and to the variable resistance, a connection between it and the relay winding and between the winding and the key and a connection between the key and the jack plug and the ground.

988,099.—Flexible Conducting Cord.



988,104.—Sign.

988,176.—Alarm for Bearings.

987,768. ELECTRIC CLOCK; L. F. Stadel, Freeport, Mich. App. filed Aug. 4, 1909. Electrically driven clock with an escape wheel driven by a spring, an electromagnet for tensioning the spring and electric circuit and hand arbor actuated by the magnet independently of the spring.

987,775. ELECTRICALLY OPERATED CIRCUIT BREAKER; H. L. Van Valkenburg, Norwood, O. App. filed Oct. 27, 1905. Automatically breaks the circuit through the coil of the operating mechanism on overload by means of an auxiliary switch for automatically opening the circuit.

987,840. PROCESS FOR THE MANUFACTURE OF STEEL; S. S. Wales, Munhall, Pa. App. filed Dec. 11, 1908. Makes use of a single furnace with ordinary electrodes, the furnace having gas ports and regenerators. Introduces fluxing material and iron oxide, heats with gas, and finely treats with electric heat, for converting into steel.

987,864. OPERATOR'S SELECTIVE RINGING KEY OR SWITCH; W. W. Dean, Chicago, Ill. App. filed June 15, 1903. A key with long top plate, a post at each end, a parallel bottom plate, vertical key plungers passing through the plates, switch springs on the bottom plates and operated by the plungers and a pivoted catch-plate beneath the top plate.

987,874. SWITCHBOARD; T. A. Hammond, Passaic, N. J. App. filed March 8, 1905. Telegraph switchboard made up of units, each including a block carrying a line circuit including two jacks and a common grounding switch.

987,901. ELECTRIC FLATIRON; F. H. McManus, Boston, Mass. App. filed July 27, 1910. A chambered metal body, separate heating windings therein, a handle for the body and a switch within the body for connecting either winding in circuit and operated from the outside.

987,902. APPARATUS FOR PRODUCING OZONE; C. D. Meeker, East Orange, N. J. App. filed Aug. 4, 1910. Two concentric tubes, a conduit-box connected at its bottom to the outer tube, a cover for the box connected to the inner tube.

987,924. RECTIFYING SYSTEM FOR ALUMINUM CELL LIGHTNING ARRESTERS; C. P. Steinmetz, Schenectady, N. Y. App. filed Sept. 13, 1910. An electrolytic lightning arrester for an alternating system combined with a mercury-arc rectifier connected to derive a uni-directional potential from the system and impress it on the arrester.

987,947. ELECTROLYTICALLY REFINING ALLOYS; A. Gardner Betts, Troy, N. Y. App. filed April 19, 1909. A process of treating alloy by dissolving metals by electrolysis, depositing an alloy at the cathode and changing the condition of the solution and then depositing a different alloy.

987,953. ELECTRIC FURNACE; J. W. Brown, Lakewood, Ohio. App. filed March 5, 1910. Furnace of the ring type with air or gas circulation made in sections.

987,956. TELEGRAPHIC TRANSMITTER; G. A. Cardwell, New York, N. Y. App. filed Jan. 15, 1908. Key levers, selector bars moved thereby, normally opened circuits closed by the bars and grouped so as to transmit characteristic impulses when the bars are moved in one direction and different impulses when moved in the opposite direction.

987,979. ALTERNATING-CURRENT MOTOR AND CONTROLLING DEVICE THEREFOR; V. I. Gray, Toledo, O. App. filed April 13, 1908. Combines with the main windings, inductive auxiliary windings, comprising pairs of coils in multiple series with the main windings, bridge connections between members of each pair and means for cutting out the auxiliary windings and throwing resistance therein.

987,984. SWITCH; G. W. Hart, West Hartford, Conn. App. filed Feb. 21, 1910. Snap switch whose opening is controlled electromagnetically with a local shunt circuit for the electromagnetic means whereby the electromagnet is released from the work of putting the snap spring under tension.

987,985. SWITCH; G. W. Hart, West Hartford, Conn. App. filed June 30, 1910. Rotary snap switch for 500-volt circuits with large distance between contacts and a thin circular sheet of insulating material to prevent the arc following the switch arm.

988,004. ANNUNCIATOR; A. Lungen, New York, N. Y. App. filed Oct. 13, 1909. A pair of magnet bobbins, an armature with an arm, an angle to its body and a banner with a pair of curved flukes attached to the arm.

988,009. SIGNAL TRANSMITTER; J. McFell, Chicago, Ill. App. filed Aug. 19, 1909. For selective signaling, including a motor, a switch, a toothed actuator selectively positioned and axially moved to throw the switch in and out with means for latching the actuator upon the shaft.

988,018. FLUSH RECEPTACLES; W. J. Newton, Lynbrook, N. Y. App. filed June 26, 1909. Inserted in the wall in lieu of the usual switch mechanism. Includes a block with outside spring blades to establish electrical connection within the box, the block having tongues and protuberances to correspond to the usual operating buttons of the switch mechanism.

988,028. MOTOR CONTROL SYSTEM; W. H. Powell, Norwood, O. App. filed May 21, 1907. For rolling mills and hoisting machinery, including a motor, a generator supplying its armature, a rotary controller for the field of the generator and a manually-controlled rotary motor for operating the controller.

988,042. ELECTRIC METER; G. E. Stevens, Lynn, Mass. App. filed Aug. 31, 1905. A meter with an armature, a field coil in inductive relation thereto, a plate on each side of the coil and lacing of insulating material for binding the plates and coils together, particularly for integrating meters of the commutator type.

988,044. TELEPHONE RECEIVER; H. R. Stuart, Wheeling, W. Va. App. filed March 21, 1908. Multiple pole electromagnetic receiver for loud-speaking telephone,, including a tube, a disk, a ring and one or more magnets for magnetizing the ring and tube with opposite polarity.

988,067. ELECTRIC LOCOMOTIVE; A. F. Batchelder, Schenectady, N. Y. App. filed April 7, 1909. A plurality of driving wheels, a jack shaft in the plane of the axles of the wheels, a motor over the driving wheels, the plane of the motor shaft and of the jack shaft meeting at an angle and a crank and connecting-rod connections between the driving wheels and jack shaft and the jack shaft and rotor of the motor.

988,093. SYSTEM FOR CONTROLLING ELECTRIC CIRCUITS; G. W. Hart, West Hartford, Conn. App. filed June 30, 1910. A plurality of branch circuits with electromagnetically controlled switches so interconnected as to be controlled electromagnetically from a single point so as to open their respective branch circuits.

988,094. SWITCH; G. W. Hart, West Hartford, Conn. App. filed July 7, 1910. Double snap switch of the two push-button type with an oscillating actuating member. Details.

988,099. FLEXIBLE CONDUCTING CORD; O. Hoffstrom, Chicago, Ill. App. filed July 26, 1907. A flexible cord having graded layer with resilient insulated strands in one direction and conducting strands in the other, the latter grouped to form concentric conducting spirals, each spiral including a plurality of conducting strands.

988,104. SIGN; R. G. Jenckes, Manaos, Brazil. App. filed June 25, 1910. A luminous display device, including a vessel with a window containing an electrolyte, a film-coated electrode in the form of a letter mounted in the vessel to register with the window, a second electrode in the vessel, the current producing a luminous film.

988,148. MANUFACTURE OF FILAMENTS FOR INCANDESCENT LAMPS; C. P. Steinmetz, Schenectady, N. Y. App. filed April 30, 1904. Treats filaments with penta-fluorid of iodin.

988,162. ELECTRIC SIGNALING MEANS; A. J. Allard, Richmond, Va. App. filed Oct. 29, 1910. For indicating broken wheel flanges by means of electrical circuits co-operating with the wheel flange and a signal, operative upon a break in the flange.

988,171. FIRE ALARM SYSTEM; H. B. Bush, Littleton, Colo. App. filed May 25, 1909. A fire alarm system, including a drop, a circuit controlling it, a solenoid, a visible signal, a bridge plate operated by the solenoid to close the signal and an audible alarm.

988,176. ALARM FOR BEARINGS; A. H. De Lage, Alpena, Mich. App. filed June 14, 1910. A mercury tube with a neck containing contacts, wires connecting the contacts and ferrules so as to sound an alarm when in danger of hot box.

988,192. ELECTRICAL TESTING DEVICE; C. A. Hetherington, Des Moines, Ia. App. filed Dec. 20, 1909. A screwdriver with a testing device in its handle for testing circuits for voltage, etc.